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ABSTRACT

Technology is having a major impact on living in industrialized countries like Australia. Academics such as geographers in Australian institutions of higher education should have a thorough understanding of the concept of technology and be effective users of it if they are to be educational leaders. As one of the first of its kind in Australia, a study was conducted among the institutions of higher education in Australia to find our the impact of technology amongst geographers. The study was based on the belief that the impact of technology can be determined by investigating the following aspects: the geographers' understanding of the concept of technology; their attitudes toward technology; the competencies that they claim in technology; the uses to which they put technology in their professional activities of teaching, research and consultancy; and the perceived impact that technology has had on them as geographers. Some 88 geographers from universities around Australia responded to a postal survey. Analyses of their responses revealed that these geographers had a conception of technology that is dominated by hard technologies, some of which may be termed new technologies. They expressed limited understanding of soft technologies. Overall, their attitudes towards technologies may be termed as ambivalent. This was due to a number of factors including a narrow understanding of technology, frustration with selected technologies and mixed access to items of hard technology. The implications of this study are that geographers in Australian institutions of higher education need exposure to a broader concept of technology so that they can understand both hard and soft technologies and be able to use them in their teaching, research, and consultancy. This exposure can be achieved through a carefully-planned in-service program involving all members of geography departments in Australian universities. (Author)

THE ROYAL GEOGRAPHICAL SOCIETY OF QUEENSLAND INC. 1885

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TECHNOLOGY EDUCATION AND GEOGRAPHY IN AUSTRALIAN HIGHER EDUCATION

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ABSTRACT
Technology is having a major impact on living in industrialised countries like Australia. Academics such as geographers in our institutions of higher education should have a thorough understanding of the concept of technology and be effective users of it if they are educational leaders. The concept of technology that has currently been defined consists of objects, processes and organisation. It is convenient to talk of hard technologies as the technological hardware and soft technologies as the methods for organising the hard technologies.

As one of the first of its kind in Australia, a study was conducted amongst the institutions of higher education in Australia to find out the impact of technology amongst geographers. The study was based on the beliefs that the impact of technology can be determined by investigating the following aspects: the geographers' understanding of the concept of technology; their attitudes towards technology; the competencies that they claim in technology; the uses to which they put technolo[illegible] their professional activities of teaching,research and consultancy; and the [illegible]ed impact that t[illegible]nology has had on them as geographers.

Some eighty-eight geographers from universities around Australia responded to a postal survey. Analyses of their responses revealed that these geographers had a conception of technology that is dominated by hard technologies, some which may be termed new technologies. They expressed limited understanding of soft technologies. Overall, their attitudes towards technology may be termed as ambivalent. This was due to a number of factors including a narrow understanding of technology, frustration with selected technologies and mixed access to items of hard technology. Their competencies in and uses of technology were quite mixed. Geographers specialising in geographical information tended to be most competent in and made most use of hard technologies. Limited competence in and use of soft technologies was noted across this group of geographers. Despite these mixed results the geographers generally felt that they had received considerable impact from technology in their professional activities.

The implications of this study are that geographers in Australian institutions of higher education need exposure to a broader concept of technology so that can both understand hard and soft technologies and are able to use them in their teaching, research and consultancy. This exposure can be achieved through a carefully-planned in-service program involving all members of geography departments in Australian universities.

INTRODUCTION

The impact of technology on the lives of Australians has been considerable in the last twenty years and will become increasingly powerful as life moves into the twenty-first century. Australians have adopted all forms of machinery and equipment in the many facets of their lives. They enjoy the products of technology in recreation, work, education and in their private lives. In doing so, some people have developed distinctive skills and competencies that can be used to live more effectively and efficiently and which can be used to conduct research and development investigations.

Statements made by contemporary Australian Government sources emphasise the need to focus on the critical role of technology in the development of the Australian society. For instance, Senator Button, the Commonwealth Minister for Industry, Technology and Commerce stated:

> "Changing world circumstances have demonstrated that Australia must shift its reliance on traditional rural and mineral exports if the general economic welfare of the country is to be maintained and increased.
>
> Over the past four years, the Government has embarked upon an industry and technology strategy of encouraging innovation and new technological development. The process has involved planned gradual reduction in industry protection, improvement of industry infrastructure, and the provision of incentives to encourage industry to concentrate on areas of maximum competitive strength. Technological innovation is a vital element of that strategy.
>
> In fact, new technologies and innovation are crucial to the revitalisation of existing industries and the creation of new industrial opportunities."
>
> (DITAC, 1987:iii)

The Standing Committee on Employment, Education and Training for the Commonwealth House of Representatives (1989:1) noted that:

> "A workforce that is well educated and trained is likely to be creative, and able to shape and respond to change. Its basic knowledge and skills have depth and diversity. These qualities are important factors in improving productivity, attracting investment and adapting to structural change."

It emphasises the place of "new technology" in enabling this to occur through improved educational access and outcomes. Also, in its Annual Report, the Commonwealth Department of Industry, Technology and Commerce (1987) called on Australians "to develop a productive culture with more favourable attitudes towards innovation, entrepreneurship and high quality standards in the areas of design, production and marketing". In this new economic order the government policy has been designed to improve technological efficiency through the shift away from regulation towards "exposing Australia to the rigours of the market place and thereby ensuring that decisions are based on efficiency. It goes without saying that efficiency and the use of technology in this context are synonymous." (Dupe,1988:1)

Australia is inextricably linked to the rest of the world in its development and use of technology. Lepani (1989:1), Johnston, et al. (1989) and Scott-Kemmis (1989) stress that technology is now the major determinant of patterns of world trade and investment. By the early 1990s they predicted that 40 per cent of world trade, by value, will be in information technology. They see markets becoming globalised, and companies, technology and the division of labour being internationalised. Therefore, Australia is caught up in a "a crisis of structural change" as it adjusts to a new techno-economic paradigm that will cause changes in its socio-institutional arrangements. The Centre for Technology and Social Change(TASC, 1990:vi) in its report on the strategic alliances that should be developed internationally by Australian industry confirms this view in the following statement:

> "The internationalisation of Australian industry is the central challenge of industry and technology policy for the 1990s. Consumption of industrial goods and services is highly internationalised, reflecting the strong convergence among OECD economies. But industrial production activities are adapting slowly and lag in the internationalisation process. Import substitution policies have resulted more in the partial Australianisation of foreign capital and technology than in the internationalisation of Australian firms. The social, economic and technological infrastructure most directly linked with industrial production and export has not been shaped through a history of international competitive pressure and related structural change."

One of the powerful trends that underlie this process of change and necessitates "a continuous strategic adjustment" is technology and industry convergence driven by the development and diffusion of generic technologies such as information technology and biotechnology (TASC,1990:9-11). The international strategic alliances being described in this process of change are part of a broader, expanding network of co-operative links characterised by research co-operation, industrial networks and the accessing of complementary assets for production and marketing. It is in the area of research co-operation that geographers in Australian universities, like their colleagues in other disciplines, are being encouraged to expand their research projects through collaboration with private and public companies and other academics both within Australia and internationally. Such alliances enable university geographers to acquire specific pieces of technology and technological processes through contract research and consultancy.

It is in this context that Australian university geographers interact with technology in the 1990s. The extent of this interaction is dependent on a range of factors that include the emerging national and international context described above. It also relates to: the understanding of the concept of technology, attitudes towards technology, competence in different forms of technology and the perceived relevance of this technology to higher education that Australian university geographers believe and practise. Before investigating the Australian situation, it is necessary to clarify these factors.

THE CONCEPT OF TECHNOLOGY

Lepani et al. (1990:22) claim that

> "History reveals the power of certain technological innovations to transform the mental life of an era - the feelings, sensibilities, perceptions, expectations, assumptions, above all, possibilities that define a community."

Zuboff (1988:8-11) uses the example of information technology to demonstrate how this innovation can be seen as a change to the material extent of our world with transformative implications for our lives:

> "When the technology informates the processes to which it is applied it increases the explicit information content of tasks and sets into motion a series of dynamics that will ultimately reconfigure the nature of work and social relationships that organise productive activity .... Information technology not only produces activity, but produces data about the activity. Thus it produces a 'voice' that symbolically renders events, objects and processes so that they become visible, knowable and shareable

in a new way."

These statements indicate that it is no longer possible to think of technology as some form of industrial artefact. Gerber(1990:1-2), in an attempt to synthesise recent conceptions of technology, concluded that the concept of technology is certainly a much broader, inclusive one that involves: objects, e.g. artefacts; processes, e.g. skills, procedures, routines, and techniques; and organisation, e.g. social organisation of human activity, relationships between components in an organised structure, networks and power patterns.

One meaningful way to conceptualise technology is to sub-divide it into two categories - the hardware or hard technologies and the methods for organising it or the soft technologies. Various attempts have been made to classify the hard technologies that have dominated the thinking of many governments since the 1960s. The Japanese Government, through its Council for Science and Technology and the Ministry of International Trade and Industry have classified the hard technologies as follows:
1. Biotechnology(life sciences);
2. Advanced industrial materials;
3. Information technology;
4. Communications technology;
5. Manufacturing and processing technologies;
6. Energy technologies; and
7. Aerospace technologies.(DITAC, 1987:21-22)

Similar categories were identified in the European Economic Community's research strategy of 1983 (DITAC, 1987:12-13). The U.S. Department of Commerce elaborated the nature of these categories by specifying the technologies that businesses could invest in. This list has been summarised by DITAC in Table 1 below(1987:30-31). Lepani et al. (1990:23), in Figure 1, specified the main technology clusters in product innovation as a microelectronic cluster and a biotechnology cluster. They linked the user industries to each cluster to demonstrate the relevance of the technologies to economic development.

Table 1 U.S. Department of Commerce - Categories of New Hard Technology and Possible Business Opportunities

TECHNOLOGY CATEGORY	ENABLING TECHNOLOGY
Biotechnology	* Recombinant DNA * Animal vaccines * Animal growth hormones * Plant growth regulators * Cell/tissue culture * Microbial pesticides (cloned) * Disease resistance in plants * Immune response * Drug delivery - controlled response * Monoclonal diagnostics (plants/pests) * Fermentation technology * Enzyme biocatalysis * Computer modelling of drug action

Advanced materials	• Carbon fibres • Matrix resins • Reinforcing fibres/ fillers • Formulations/ fabrication • Composites • Ceramics - powder synthesis, toughness, fabrication, joining methods • Amorphous metals • Alloys
Information technologies	• Office automation - erasable optical storage, software/artificial intelligence, device standards • Computers - multiprocessors, optical switching • Sensors • Bioelectronics - sensors • Computer architecture • High speed printing
Communications	• LANS • Standardised interfaces • Voice technology • Optical switches • Optical amplifiers • Heavy metal fluoride - fibres • Fibres of 10.6 micron capability
Manufacturing and processing technology	• Microelectronics applications to metrology • CIM/CAD/CAM • Robotics • Flexible manufacturing (FMS) • Machine tools • Sensors - force, etc. • Third vision systems • Lasers
Energy technologies	• Coal • On-line analysis • Fuel cells • Laser enrichment of uranium • Corrosion monitoring and control (on-line) • Amorphous metals - transformers • Stack gas cleaning • Groundscan radar • Fibre reinforced ceramics • Alloys for engines
Aerospace	• (Too detailed to cover)

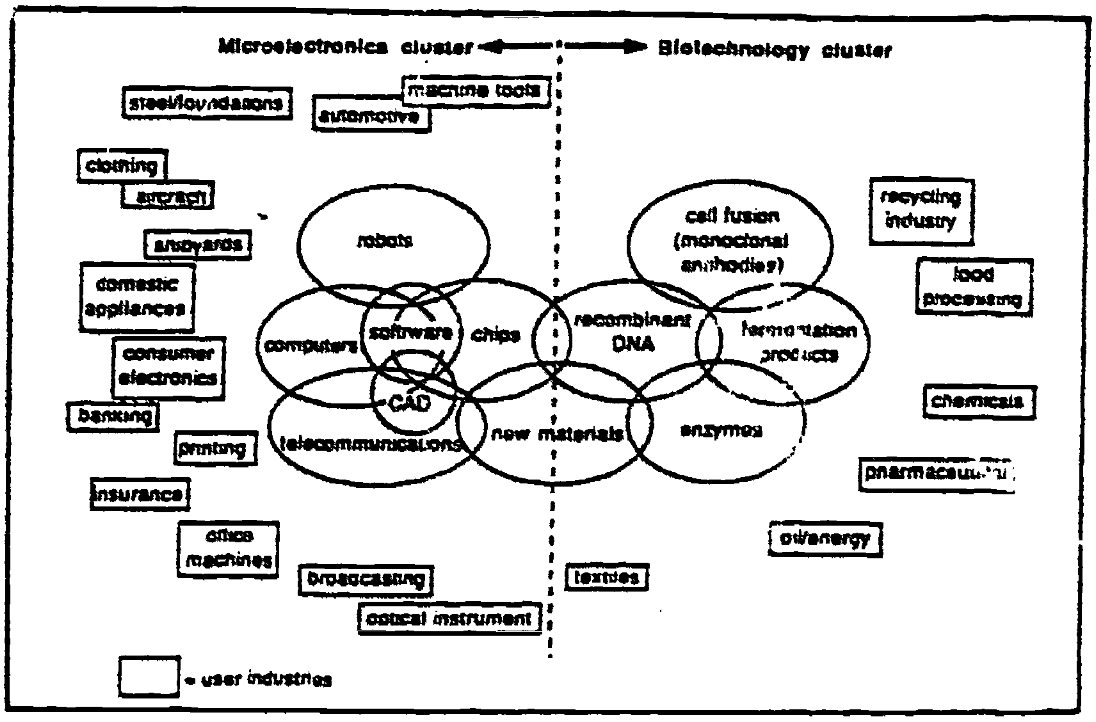

Figure 1 Hard Technologies - Main Technology Clusters in Product Innovation

Therefore, the Commonwealth Department of Industry, Technology and Commerce (1987:38-40) believes that hard technologies can be defined on the following levels:

<u>Level 1</u> The broad categories that are generic to all future industrial development. These are: biotechnology, advanced industrial materials, information technology, communications technology, manufacturing and processing, energy and aerospace.

<u>Level 2</u> Component or enabling technologies which enhance the development of the broad categories and assist in the identification of some of the potential markets for the ultimate products of these developments. For example, in the information technology category, examples could include: microelectronics, computers, software, artificial intelligence, bioelectronics and office automation.

<u>Level 3</u> Support technologies that will limit the multiple cross-over links that may occur in Level 2 and/or will link with another technology which provides access to distinct markets. Examples of this level include infrastructural materials such as optical componentry as sources for the development of laser devices or new pure gases.

<u>Soft technologies</u>, on the other hand, are the forms of organisation and thinking that enable the hard technologies to be implemented effectively and efficiently. They include the following:

1. systems learning;
2. management methods;
3. methods of group integration in conditions of uncertainty;
4. interpersonal communication skills;
5. cross-cultural learning and communication;
6. enterprising skills;
7. design/aesthetic skills;

8. visioning (including imagining possible futures);
9. networking across disciplines, organisations and cultures; and
10. pattern recognition (including intellectual and business opportunities, problem identification and collaboration). (Lepani et al., 1990:23–24)

These soft technologies are fundamental in developing a complete understanding of the concept of technology. Without them, people cannot appreciate the impact of specific new generic hard technologies on organisations, disciplines such as Geography and on living in general. For example, the possession of enterprising skills is now as necessary as academic and vocational qualifications for all individuals who wish to participate fully in modern society (Ball,1989). Ball has specified that such an enterprising person would:
1. have a positive, flexible and adaptive disposition towards change;
2. possess the capacity to initiate creative ideas and to develop them through into action in a planned manner;
3. be at ease when dealing with insecurity, risks, difficulty and the unknown;
4. possess a security borne of self-confidence;
5. be able to take responsibility;
6. be an effective communicator, negotiator, organiser, lobbyist and planner; and
7. be active, confident and purposeful.

Therefore, technology is effective when the hard and soft technologies are integrated in practice in a particular social context. University academics in geography have the specific contexts of higher education, research and consultancy in which to develop and apply their concept of technology. To date, there is no evidence to appreciate what conceptualisation that these academics make of technology and how they put this understanding into practice.

ATTITUDES TO TECHNOLOGY

Technology has an insidious impact on living as people are exposed to different products that are the results of the use of different hard and soft technologies. Through such a process people in industrialised countries become dependent on technology for living. This process is made all the more powerful if people also exhibit positive attitudes towards technology. Such attitudes can produce a definite commitment to technology that promotes both effectiveness and efficiency.

Recent research studies in Australia, especially with adolescents, have revealed that youth, like adults, hold ambivalent attitudes towards technology. Eckersley (1988) in his investigation of youth attitudes for the Commission for the Future found: a fear for the negatives of technology, some acceptance of perceived material benefits from using technology, increased levels of social alienation and greatest "information poverty" amongst members of the lower socio-economic groups. Wilson (1984) found similar degrees of ambivalence in young people's views of the world as it related to Peace Education. Lepani et al. (1990:7–8), in a comprehensive study of Australian Secondary students, found that: students are very concerned about the impact of past technologies on the natural environment; boys were more optimistic about the impact of technology on society than girls; and similar gender differences were evident in the students' attitudes to the impact of technology on their personal lives in terms of employment opportunities, lifestyle, creative work and education.

It is highly probable that these attitudes persist into adulthood. They are likely to be adjusted through a variety of experiences. However, the degree of optimism towards technology is not likely to change greatly unless learning experiences, both formally in educational and occupational contexts and informally in other lived contexts, are adjusted to accommodate more effective uses of both hard and soft technologies. There is no reason to believe that geographers in higher education in Australian universities are any different in their attitudes towards technology.

COMPETENCE IN DIFFERENT FORMS OF TECHNOLOGY

In a submission to the Commonwealth Government Inquiry on the potential of new technology, particularly satellite technology, to improve educational access and outcomes in Australia, one witness stated:

> "To interface adequately with technology, teachers, like many other groups in society, require a number of facilitating factors to exist. These factors include, an enthusiasm to use technology, adequate pre-service and in-service education, informed and supportive specialist advisory staff, adequate and compatible hardware, and educational software that is not only technically compatible, but compatible with teachers' educational philosophies." (Millar,1989)

The first two factors mentioned are underpinned by people possessing competence in both hard and soft technologies relevant to their personal and professional situations. This was highlighted by a witness who stated to the same inquiry:

> "I think one of the highest obstacles preventing the spread of the use of technologies is the lack of experienced practitioners, of high level people. You see this at the tertiary institutions; you see it right down to the school level. There are very few people, in my view, who really know what it is all about and have the expertise and the experience to implement programs, conduct the research and so on ..... To me the bottom line of the whole issue, of all the issues of information technologies in education, is professional development and training..." (Winship,1989:165)

Further, a witness from the Western Australian Department of Employment and Training explained that:

> "From the perspective of my Department, there is within the State now a massive need for retraining and skills upgrading within the workforce. The present structures cannot cater for this new demand for skills training. The need for more skilled trainers will become acute as the industrial restructuring process and the new industrial relations and wage negotiations under the structural efficiency principle develop and become a reality." (Gosselink,1989:97)

Therefore, the Committee was moved to conclude that "in-service training, as a matter of fundamental importance to the effective use of technology in education, should be regarded by the Commonwealth as a priority are complementary to that of equipment." (Commonwealth of Australia, 1989:86)

These statements highlight perceptions gained from extensive professional experience that competence in different technologies that are relevant to educators' professional contexts is essential. The inference is that such competencies are very influential in reducing the ambivalence that many adults hold towards technology. As the Commonwealth Government Standing Committee on Employment, Education and Training concluded:

> "Training is necessary not only for overcoming uncertainty about technology but also to ensure that new technology is used to best effect. Only when users are educated in both the features of technology and the educational context in which it should be applied can the equipment and techniques be used appropriately." (Commonwealth of Australia,1989:75)

The practical difficulty of providing adequate training facilities and time for these competencies to be developed is evident in all sectors of education in Australia. However, this does not detract from the necessity to address perceived levels of competency in technology in Australian educators.

The extent of competence in technology possessed by academics in higher education in Australia is unclear because of the absence of comprehensive data in this area. It could be expected that geographers, especially those who are associated with geographical information and/or who undertake quantitative research and consultancies would possess a considerable degree of competence in technology.

RELEVANCE OF TECHNOLOGY TO GEOGRAPHY IN HIGHER EDUCATION IN AUSTRALIA

Geography in the 1990s is concerned with the study of places and spaces in order to investigate issues and solve problems associated with the relationships and interactions between people and their environment. As the Australian Geography Teachers' Association (1988:4) stated:

> "Such environments may vary between those that are relatively natural and those that have been developed and transformed by people. The spatial effects of people-environment interactions raise questions about the nature, origin, causes and consequences of these interactions. Geographers need to find answers to these questions if they are to understand the impact of human activity on physical and social environments."

As well, geography is concerned with the environmental and social effects of human actions to the extent that these reflect human understanding of the environment and provide the basis for constructive decisions for using the physical and social environments.

Technology can play an integral role in these kinds of geographical studies. It is a challenge for geographers in institutions of higher education to recognise that this is the case and to maximise the potential that technology offers. In a previous study that focussed on Secondary level geography, the author (Gerber,1990:4-6) demonstrated that technology has three main impacts on studies in geography as:

1. a means for improving data-gathering in making thorough investigations;
2. a facilitator in the development of skills; and
3. an additional explanation for spatial patterns and people-environment relationships.

By expanding these conclusions and relating them to higher education, it is proposed that technology can enhance geography in the following ways:

1. expanding one's understanding of spatial aspects of people and their environment;
2. improving the technical skills of geographers;
3. using soft technologies to reinforce inquiry or problem-solving approaches to geography;
4. enhancing the capacity of geographers for research and consultancy; and
5. expanding the opportunities for geographers to improve their networks and communication.

1. Expanding one's understanding of spatial aspects of people and their environment.

The advent of distinctive hard technologies associated with computers, satellites, databases and remote sensing, have given geographers the opportunity to acquire data both on a geographical and a numerical scale not previously possible. This data can be stored in computers and manipulated quickly using sophisticated software. Even allowing for the known degrees of error that are associated with this data, there is sufficiently accurate data from which to undertake comprehensive regional and global studies on such topics as: the impact of sedimentation in fragile littoral zones, the deforestation of specific mountainous regions, changing climatic patterns and traffic congestion in urban areas. The scale with which remotely-sensed data can be obtained enables geographers to investigate spatial patterns on a regional scale and over time in a way that was not previously possible. The movement of animals around in their habitats can now be monitored accurately using specific detection and recording devices. While these examples of geographical investigation were possible in the past, they were lengthy and time-consuming activities. The new hard technologies are enhancing the capacity of geographers to understand people's interaction with their environment more comprehensively.

2. Improving the technical skills of geographers.

New technologies offer geographers a greater range of tools for conducting investigations and the opportunity to conduct analyses more quickly than previously. The software for personal computers is becoming so sophisticated as to enable geographers to undertake their own analyses without having to use mainframe computers. Specialised field equipment enables geographers to gather more accurate data more easily. However, with this equipment there comes a cost (other than the financial cost of the equipment). It is that geographers need to learn a new range of technical skills to operate the different forms of hard technology. These skills are additional to the range of geographical and statistical skills that geographers need to learn to understand their discipline. Learning these new technical skills can be as demanding as finding the dollars to purchase the equipment. Consequently, geographers are characterised by those people who embrace the new hard technologies wholly or those who want to have little to do with these technologies.

3. Using soft technologies to reinforce inquiry or problem-solving approaches to geography.

Geographers undertake most of their investigations using the following stages:

1. Observing, recording and describing a social or physical environmental pattern problem or issue and its location or setting.
2. Explaining the causes and processes involved in producing the pattern, problem or issue.
3. Exploring and evaluating all its likely social and physical environmental effects.
4. Making decisions on the best ways to conserve and/or improve the situation after a careful analysis of all possible alternatives.
5. Taking action to implement these decisions or to bring them to the attention of other decision makers. (AGTA, 1988:5)

In doing so, they ask a range of key questions including: What? Where? How? Why? What impact? How ought? This enables geographers to make an effective decision about the issue or problem under investigation.

The range of soft technologies listed earlier in this document offer considerable scope for enhancing the above type of geographical investigation. Geographers' approaches to their investigations can take on a refreshingly innovative orientation if: their enterprising skills are well developed, they are competent at visioning, and they are willing to promote cross-cultural learning and communication. Not only will the management of these investigations take on a more efficient orientation, but it is likely that answers to the How Ought questions will be more creative and far-reaching. The orientation built into the soft technologies combined with the increased capacity from the hard technologies should produce more comprehensive geographical inquiries.

4. Enhancing the capacity of geographers for research and consultancy.

A range of recent Commonwealth government initiatives including the White

Paper on higher education, the National Teaching Company Scheme and the Training Guarantee Act have encouraged industrial groups, companies and universities to collaborate more closely on research and development projects. As the Centre for Technology and Social Policy (1990:10) notes:

> "There is a growing trend among firms to 'source' technology from e rnal suppliers (other firms, universities, etc.) through contracts and ..ious forms of collaboration - this is a key feature of change in technology strategies. These research links are also becoming increasingly international - the US computer manufacturer Digital Equipment Corporation for instance, has 200 research projects with universities around the world."

Behind these specific links and programs there is a wider process of change occurring. This is the spread of scientific and technical information. The rapidly expanding consulting industry is very active in this process. One example specific to geography is the comprehensive network of communications that has been developed by large software manufacturers such as ESRI in geographical information systems. ESRI's publication ARC News is a major device for sharing technical information and advice concerning its range of GIS software and their applications. Many of these publications are supplied free of charge to university geographers. They, together with an increasing range of technologically-oriented journals, provide a source of technological information for geographers.

As the links between industry and the universities grow closer, the impact of technology on research and consultancy in geography will expand and drive the directions of this research and consultancy. This will occur because the universities are seeking more funding support from industry. Firms which are increasingly being driven by technology will prioritise research and consultancy projects that have a technological orientation. This could well become a constraining outcome of the closer links between universities and industry and it could cause the demise of those geographical investigations that do not have a strong technological aspect to them.

5. Expanding the opportunities for geographers to improve their networks and communication.

University geographers do not only require considerable amounts of geographical information to undertake teaching, research and consultancy commitments successfully. They also require increasing access to their colleagues around Australia and around the world. A direct impact of technology has been the improvement in networks of people that have occurred through technology such as facsimile machines, electronic mail and electronic bulletin boards. Such technology permits Australian geographers to operate efficiently as members of international teaching, research and consultancy teams. No longer is there the need for face-to-face meetings to plan, implement and evaluate particular geographical projects. Teleconferencing offers an inexpensive alternative which more and more geographers are using in their professional activities. In fact, the dissemination of the results of research studies and teaching commitments can be delivered by distance education methods as effectively as by direct contact. This introduces a degree of flexibility into teaching and research that was not possible previously.

From the above five areas, it is possible to conclude that technology is very relevant to geography in higher education. What is required is an investigation of geography in higher education in Australia to establish the extent to which technology has had an impact. This investigation is the basis of the following study conducted across Australian universities in late 1990.

A STUDY OF TECHNOLOGY EDUCATION AND GEOGRAPHY IN AUSTRALIAN HIGHER EDUCATION

Purpose of the study.

This study is intended as a mapping exercise of the impact of technology amongst geographers in the Australian higher education sector. It has been planned around the beliefs that the impact of technology can be determined by investigating the following aspects with these geographers:

1. their understanding of the concept of technology;
2. attitudes that they possess toward technology;
3. competencies that they claim in technology;
4. uses to which they put technology in their professional activities; and
5. their perceived impact that technology has had on themselves as geographers.

The sample.

The Directory of Members(1990) of the Institute of Australian Geographers Inc. provided a comprehensive list of the geographers in Australian tertiary institutions. Approximately 350 academics were identified in this list from all of the institutions of higher education in Australia. As the result of the survey mentioned below eighty-eight geographers scattered throughout these institutions participated in the study. Of these, eighty (90.9%) were male and eight(9.1%) were female. The academic position of these geographers is summarised in Table 2 below where it is revealed that they are predominantly lecturers/senior lecturers (59.0%) and professors(38.6%).

Table 2 Academic Positions of Participating Geographers in Australian Institutions of Higher Education (N=88)

ACADEMIC POSITION	NUMBER (PERCENTAGE)
Professor/Associate Professor	34 (38.6)
Senior Lecturer/Lecturer	52 (59.0)
Senior Tutor/Tutor	2 (2.4)

This group of geographers come from a range of fields of interest in the discipline. As Table 3 indicates the three most common fields of interest represented in this group are: physical geography (27.2%), human geography (25.0%) and geographical information (22.7%). Few geographers represent either regional geography (6.8%) or economic geography (6.8%). Those in the "Other" category (11.3%) were mainly geographical educators.

Table 3 Main Fields of Professional Interest of Participating Geographers in Australian Institutions of Higher Education (N=88)

MAIN FIELD OF PROFESSIONAL INTEREST	NUMBER (PERCENTAGE)
Geographical information	20 (22.7)
Physical geography	24 (27.2)
Human geography	22 (25.0)
Regional geography	6 (6.8)
Economic geography	6 (6.8)

Other. e.g. Geog. Education	10 (11.3)

The ages of the geographers who participated in this study are summarised in Table 4 below. The geographers in this study fall into two categories - a middle-aged group aged between thirty and fifty years (61.3%) and an older group aged between fifty years and retirement (36.3%). Very few of these academics were aged below thirty years (2.4%).

Table 4 Ages of Participating Geographers in Australian Institutions of Higher Education (N=88)

AGES OF GEOGRAPHERS	NUMBER (PERCENTAGE)
Over 50 Years	32 (36.3)
30 - 50 Years	54 (61.3)
Under 30 Years	2 (2.4)

The professional experience of these geographers in institutions of higher education is summarised in Table 5. This data reveals that the vast majority of these geographers have more than ten years experience in institutions of higher education (81.8%).

Table 5 Years of Experience in Institutions of Higher Education for Participating Australian Geographers (N=88)

NUMBER OF YEARS OF EXPERIENCE	NUMBER (PERCENTAGE)
More than 10 Years	72 (81.8)
5 - 10 Years	6 (6.9)
Less than 5 Years	10 (11.3)

Method

This investigation is based on survey methodology in which the geographers were approached by mail to complete a written survey after they had been introduced to the purpose of the investigation through an explanatory letter. To facilitate the completion of a reasonable number of surveys across the Australian universities, bundles of the surveys were sent to the heads of each designated academic unit who were asked to distribute them to their members. This approach assumed that the Heads of each academic unit would act in good faith and distribute the surveys to their members and it did not take into account any staff absences during the period of the survey in late 1990. The geographers were given a period of one month to return their completed forms. As a result of this approach eighty-eight geographers returned completed surveys. Their responses are the bases for the analyses and interpretations that appear later in this report.

The survey instrument.
Surveys on technology and technology education are becoming more common in countries around the world. These surveys provide a range of useful inputs for such a survey in higher education because, in general, they have been designed for use in lower levels of education. The PATT survey developed by the Eindhoven University of Technology has been adapted in a number of countries, especially for Primary and Secondary students. The Centre for Technology and Social Policy at the University of Wollongong devised a comprehensive survey on technology and the Australian Secondary school student. This survey consisted of one component for the School Principal and one component for the students to complete. Also, members of the Faculty of Education at the University of British Columbia designed a survey to obtain teachers views on science-technology-society issues and computers. None of these surveys addressed all of the aspects required in this study. Consequently, a separate survey was developed based upon some of the proven ideas in the above-mentioned surveys, but including some particular adaptations for the higher education level.

The actual survey used in this investigation contains two parts:
1. A series of questions about the following personal professional details - gender, academic position, main field of professional interest, age and years of service in higher education.

In this survey academic position was arranged in three groupings - professorial level, lecturer/senior lecturer and tutor levels. Professional interest fields were classified into the following categories - geographical information, physical geography, human geography, regional geography, economic geography and other areas. Age was classified into three groups - over 50 years, 30-50 years and under 30 years. Years of service in higher education was also classified into three groups - more than 10 years, 3-10 years and less than three years.

2. A series of questions about the following aspects of technology and technology education - the conceptualisation of technology, attitudes towards technology, competence in technology, the use of technology in professional activities, and the perceived impact of technology on one's professional activities.

The conceptualisation of technology consisted of three components - a listing of the basic definition of technology, a rating of a wide range of hard and soft technologies and the construction of an idea map to show the application and impacts of a core hard technology. Nine statements concerning the role and impact of technology in living and the extent to which people can control technology were devised to obtain expressions of geographers' attitudes towards technology. Competence in technology consisted of an extensive list of hard and soft technologies in which the respondents were asked to declare their knowledge of the technology and their competence in using it in their professional activities. The use of technology consisted of the following components - a rating of accessibility to a range of hard technologies and a rating of the use that is made of these technologies in teaching, research and consultancy. The perceived impact of technology on one's professional activities consisted of a listing of examples in regard to teaching, research and consultancy and an overall rating of the extent of this impact. Respondents were encouraged to make relevant written comments throughout the survey to elaborate any of their responses.

A variety of responses was sought in regard to these questions. In Part 1 of the survey respondents were asked to tick the relevant box from pre-determined categories or intervals of data. In Part 2 the responses required were more varied as they reflected the information required. They consisted of closed and open-ended responses. The closed responses consisted of: three-, four- and five-point rating scales in which respondents were asked to rate their degree of commitment to selected information, Yes/No responses to queries about competence in technology and one item of ticking the box for the perceived impact of technology on one's professional activities. The open-ended responses consisted of written lists or comments and the construction of a graphic to allow the respondents the opportunity to supply their own relevant information on selected questions.

Presentation and analyses of data

The data collected in this study falls into two categories - that obtained from Part 1 of the survey which consists of five independent variables concerning the personal and professional attributes of the geographers in the sample and that from Part 2 of the survey which consists of dependent variables in five areas of technology and technology education. Because this data has been collected in a variety of forms the analyses that will be reported here will consist of a combination of qualitative and quantitative statements. Within the qualitative statements an attempt will be made to seek any relevant generalisations. Within the quantitative data, statistical analyses will be computed relevant to the data. These will include the calculation of frequencies and correlations where they are appropriate. The actual statistical computations will be made using the SAS package for personal computers.

1. Conceptualisation of technology.

An introductory task for the participating geographers was to make a written description of the concept of technology in terms of their involvement in the discipline. This was intended to elicit an initial understanding of technology in a familiar context, i.e. their workplace. It was not intended to be a comprehensive definition of technology.

The responses to this initial task are generally quite revealing because of their narrowness. Only one geographer saw that technology extended beyond artefacts and the skills to use them. This person saw technology as:

> "The equipment, software, methods and products of people's ability to harness ideas for improving the way that we live."

One economic geographer stated:

> "I am teaching and researching in a field of economic geography concerned with technological change. Hence my involvement is with production technologies (and, to a lesser extent, materials handling and transport) and information technologies. These have begun to converge because of microelectronics. A sub-set of this is an involvement in:(a) research and development and (b) 'spatial' perspectives such as technology parks."

Even with this acknowledged technological focus, this geographer still placed a heavy emphasis on hard technologies only.

Most of the responses to this task placed a very heavy emphasis on technology as the "tools for the job". They are typified by responses such as the following:

- "Technology allows geographers to analyse, visualise and process large amounts of data to assist in the understanding of spatial distributions, determination of spatial processes and prediction of human and physical spatial relationships and their interactions. Technology is a synergism of theory, principles, methodology and software that allows a modern geographer to do his or her work. Judgement is required in choosing appropriate technology to assist in a study as well as the evaluation of results. A tool is still a tool - the results of the application of the tool are totally dependent on the knowledge and skill of the user."

- "Data acquisition systems; data manipulation procedures and devices (i.e. computers); data presentation equipment; devices used in teaching."

- "1. Tools which assist in collating, categorising and analysing data, but not to interpret results.
2. Tools which assist in more efficient production of research, e.g. word-processors, statistical packages.
3. Tools for teaching, e.g. AV equipment."

One experienced geographer extended this type of response by injecting the idea of a "generation gap" amongst geographers with regard to technology:

"Technology means little to me, beyond the use of maps and photographs. I do not use a computer, but am glad of the improved secretarial services available through new office technology. I find the new library technology confusing. Perhaps, this is because of my age, and my belief that technology can never take the place of hard thinking."

Together, these responses emphasise the machine-driven devices and techniques that are now available to geographers to perform tasks in spatial data collection, analysis or display.

The second task in this section involved the geographers giving ratings to a wide range of hard and soft technologies according to their beliefs of the centrality of each of these elements to the concept of technology. A list of eighteen items were included for this purpose. They consisted of ten hard technologies and ten soft technologies. The hard technologies were sub-divided into two clusters - a microelectronics cluster and a biotechnology cluster. The geographers were asked to rate each of the items in terms of their perceived centrality to the concept of technology on a five-point scale ranging from 'definitely'(5) to 'definitely not'(1). Their responses were analysed on the basis of frequencies of responses and correlations between the dependent and independent variables. In this case the dependent variables consisted of aggregated totals for: the microelectronics cluster(six items), the biotechnology cluster (four items), the hard technology items, the soft technology items and all items of technology.

The geographers' ratings for the twenty items of technology are summarised in Table 6. An analysis of these ratings reveals clearer views concerning hard technologies than soft technologies. The six items from "Robots" to "Telecommunication" represent hard technologies in the microelectronics cluster and the remaining four hard technology items, i.e. "Enzymes" to "Fermentation Processes", represent the biotechnology cluster. Geographers believe strongly that all items in the microelectronics cluster are central to the concept of technology. They are less convinced about the biotechnology items. While between fifteen and nineteen per cent of these geographers are unsure about these biotechnological items, a majority of them feel that each of these items probably or definitely are not core elements in the concept of technology.

The geographers' ratings concerning the ten items of soft technology, i.e. "Networking" to "Pattern recognition", were generally quite divided. Networking was the only item that they strongly supported while interpersonal communication skills was the only item that a majority of geographers did not support. Of the remaining items, the geographers felt: positive about visioning and design/aesthetic skills; negative about enterprising skills, cross-cultural learning and communication and methods of group integration in conditions of uncertainty; and evenly divided on management methods, systems/group based learning and pattern recognition.

Overall, this data reinforces the written statements of the geographers with their emphasis on hard technologies. However, when specific soft technologies are mentioned, a considerable number of these geographers acknowledge the possibility of some of them being central to the concept of technology. This is a positive sign for technology and geography in higher education.

Table 6 Ratings by Participating Geographers of Hard and Soft Technologies as Core Elements in their Concept of Technology by Number and Percentage(N=88)

ITEM	RATING 5	RATING 4	RATING 3	RATING 2	RATING 1
Robots	38(43.3)	20(22.7)	12(13.6)	9(10.2)	9(10.2)
Computers	86(97.7)	-	-	-	2(2.3)
Software	84(95.4)	-	2(2.3)	-	2(2.3)
Micro Chips	72(81.8)	6(6.8)	6(6.8)	2(2.3)	2(2.3)
Computer-assisted drafting	66(75.0)	20(22.0)	-	-	2(2.3)
Telecommunication	72(81.8)	10(11.3)	2(2.3)	2(2.3)	2(2.3)
Enzymes	18(20.5)	12(13.6)	14(15.9)	24(27.2)	20(22.7)
Recombinant DNA	22(25.0)	8(9.1)	16(18.2)	20(22.7)	22(25.0)
Cell Fusion	22(25.0)	12(13.6)	14(15.9)	18(20.5)	22(25.0)
Fermentation Products	22(25.0)	14(15.9)	14(15.9)	18(20.5)	20(22.7)
Networking	50(56.8)	20(22.7)	12(13.6)	2(2.3)	4(4.6)
Visioning	20(22.7)	18(20.5)	18(20.5)	12(13.6)	20(22.7)
Interpersonal Communication Skills	20(22.7)	16(18.2)	6(6.8)	18(20.5)	28(31.8)
Management Methods	22(25.0)	16(18.2)	12(13.6)	14(15.9)	24(27.2)
Enterprising Skills	16(18.2)	18(20.5)	14(15.9)	14(15.9)	26(29.5)
Design/Aesthetic Skills	18(20.5)	26(29.5)	18(20.5)	6(6.8)	14(15.9)
Cross-cultural Learning and Communication	14(15.9)	20(22.7)	12(13.6)	20(22.7)	22(25.0)
Systems/Group Based Learning	20(22.7)	18(20.5)	14(15.9)	16(18.2)	20(22.7)

Methods of Group Integration in Conditions of Uncertainty	14(15.9)	18(20.5)	18(20.5)	14(15.9)	24(27.2)
Pattern Recognition	22(25.0)	18(20.5)	12(13.6)	16(18.2)	20(22.7)

Rating 5 = Definitely; Rating 4 = Probably; Rating 3 = Not sure;
Rating 2 = Probably not; Rating 1 = Definitely not.

The calculation of Spearman correlation co-efficients amongst the independent variables and these hard and soft technologies were computed to determine any relationships between the geographers' attributes and their ratings of these hard and soft technologies. The results of these calculations are summarised in Table 7. As revealed in this Table, none of these computations produced significant relationships among the five independent variables and any of the clusters of technology in the survey. This points to a homogeneity in viewpoint towards technology by geographers in Australian higher education institutions according to gender, academic position, major field of interest, age and experience in higher education.

Table 7 Spearman Correlation Co-efficients between Five Independent Variables and Hard and Soft Technologies for Participating Geographers(Probability) (N=88)

	GENDER	ACADEMIC POSITION	MAIN FIELD OF INTEREST	AGE	HIGHER EDUC.EXP.
HARD TECHNOLOGY - M'ELECTRONICS	-0.13563 (0.3859)	-0.14732 (0.3458)	-0.12032 (0.4422)	0.23302 (0.1326)	-0.07663 (0.6252)
HARD TECHNOLOGY - BIOTECH.	-0.01628 (0.9175)	-0.18657 (0.2310)	-0.12627 (0.4197)	0.05629 (0.7199)	-0.10266 (0.5124)
TOTAL HARD TECHNOLOGY	-0.03230 (0.8371)	-0.23061 (0.1368)	-0.17245 (0.2688)	0.09188 (0.5579)	-0.08618 (0.5827)
SOFT TECHNOLOGY	0.10333 (0.5096)	-0.18461 (0.2360)	-0.14218 (0.3631)	0.11772 (0.4522)	0.04773 (0.7612)
TOTAL TECHNOLOGY	-0.00645 (0.9672)	-0.24689 (0.1120)	-0.15774 (0.3124)	0.07213 (0.6458)	-0.03753 (0.8112)

The third task that the geographers were required to complete concerning their conceptualisation of technology was to draw an idea map - graphic conceptualisation of technology. In this case, they were given the term "computers" as the starting point for the graphic. This technique allows individuals to express their conceptualisations through key words and linkages and so give a further insight into their understanding of technology. These graphics may be interpreted by categorising the key words and the structure of the expressed linkages.

The idea maps of he geographers that were completed during the survey revealed further insights about these geographers and their conceptualisations of technology. The most common response was a purely hard technological view as illustrated in Figures 2 and 3. Here, computers drive the technology for these geographers. All of the technical activities that these geographers have noted are connected to computers in some form.

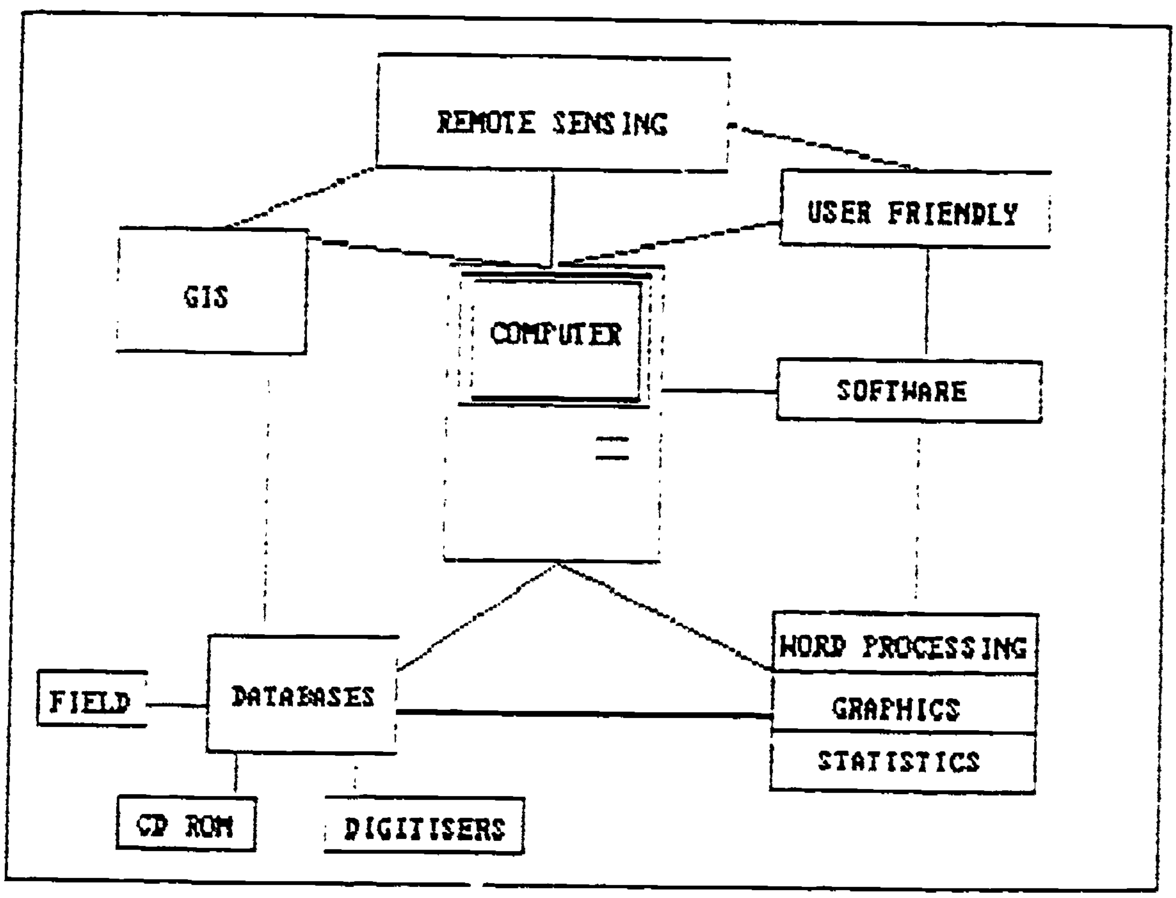

Figure 2 A Geographer's Conventional View of Technology as being Computer-driven

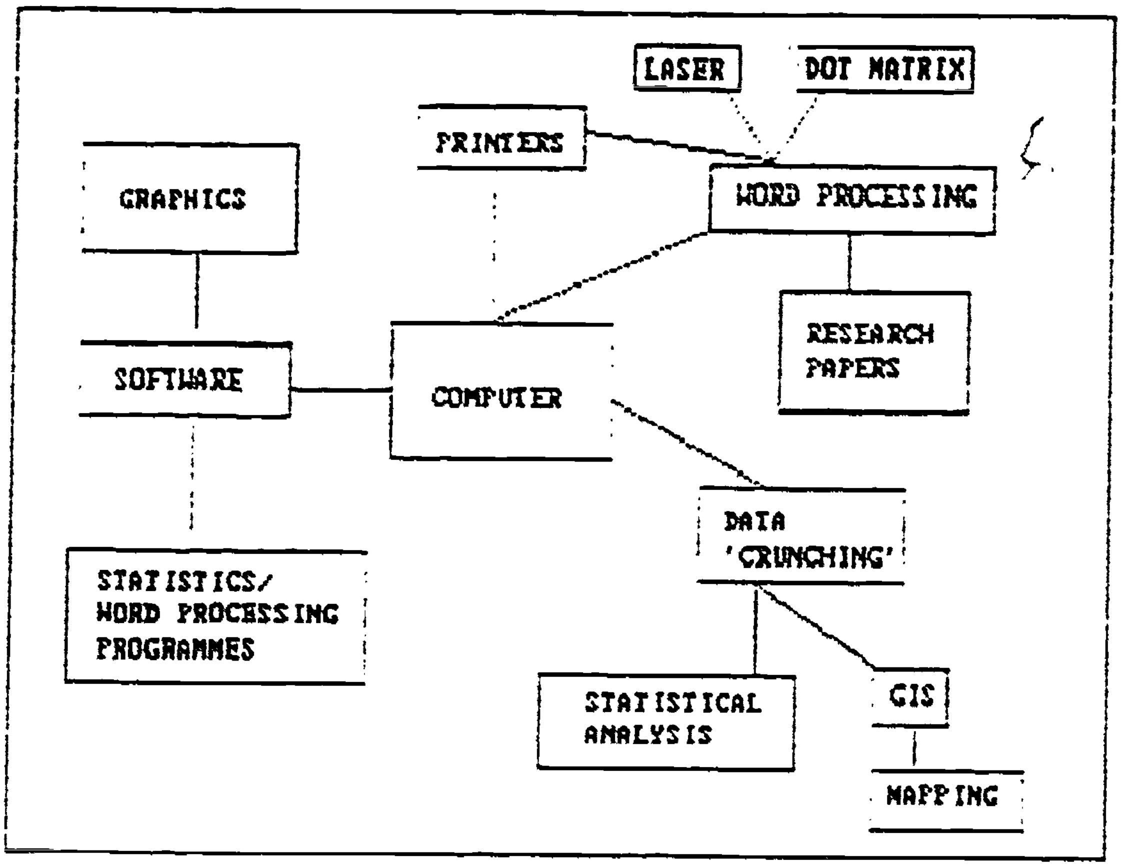

Figure 3 A Geographer's View of Technology as being Dominated by Hard Technologies

The geographer in Figure 4 maintained this view of technology, but is very astute in realising that in the technocratic world which characterises many institutions of higher education in Australia it is deemed to be a sign of currency if one is a high profile user of technology. Permanency(tenure) of one's academic position and promotion may be enhanced if an academic is technologically active.

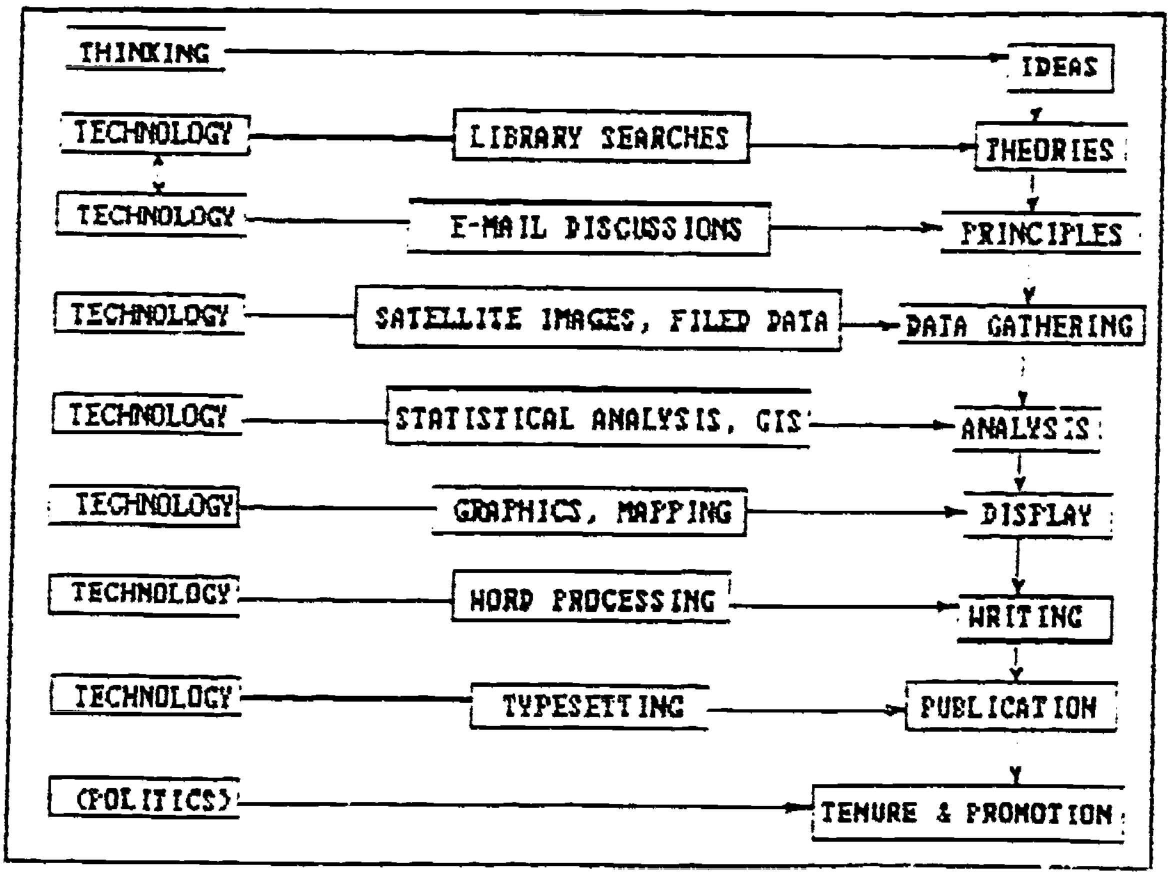

Figure 4 A Geographer's view of Technology as Hard Technology and a Means for Advancement

This next idea map (Figure 5) has been included because, although it is basically a "hard technology" conceptualisation, it implies that geographers can become slaves to technology once they become competent in its different forms.

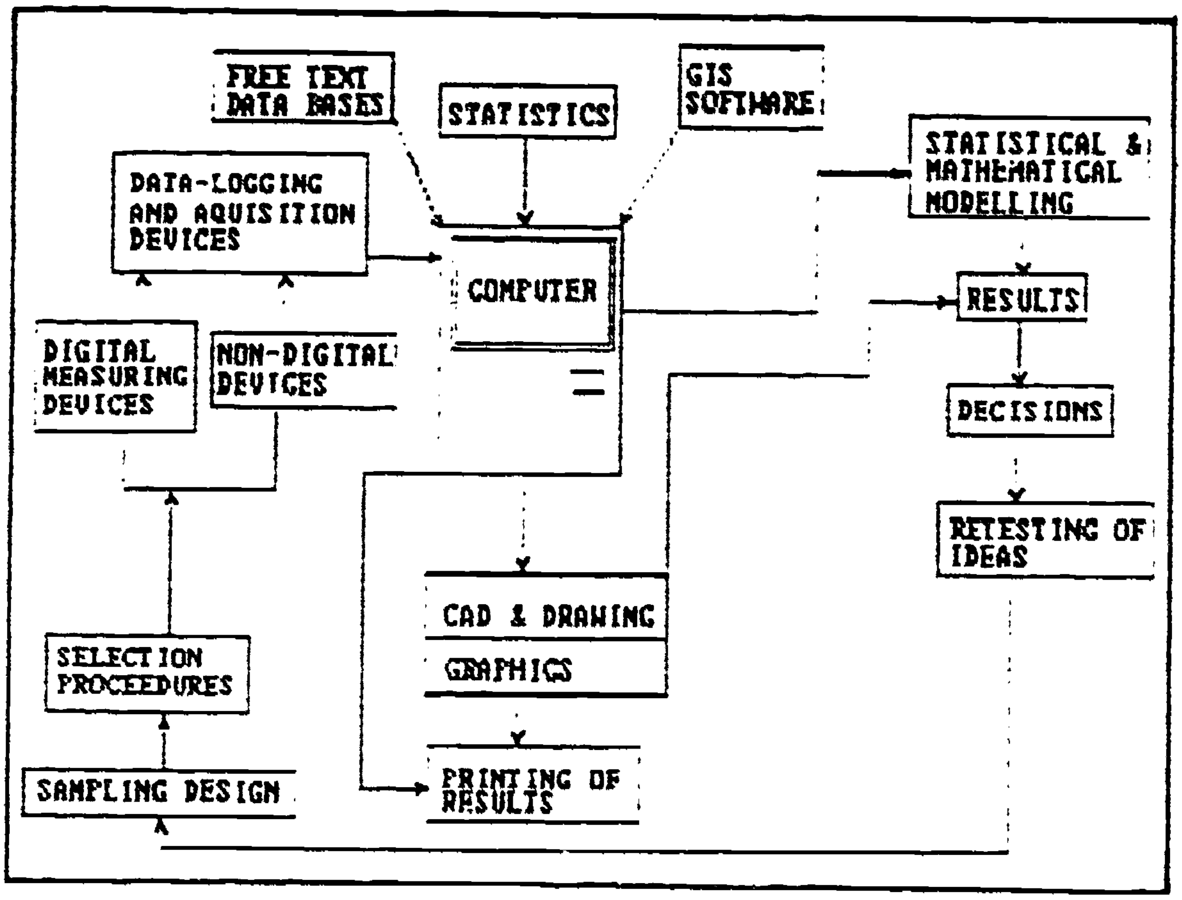

Figure 5 A Geographer's view of the "Closed Circuit" Technology Treadmill

There were some geographers who incorporated both hard and soft technologies in their idea maps. Figures 6 and 7 are illustrations of this type of response. While the hard technologies dominate overall, in Figure 6 the geographer has recognised the importance of networking and in Figure 7 the importance of management skills in using these hard technologies is identified. While these aspects may appear minor in the scheme of each graphic, they do highlight the fact that some geographers possess a broader understanding of technology.

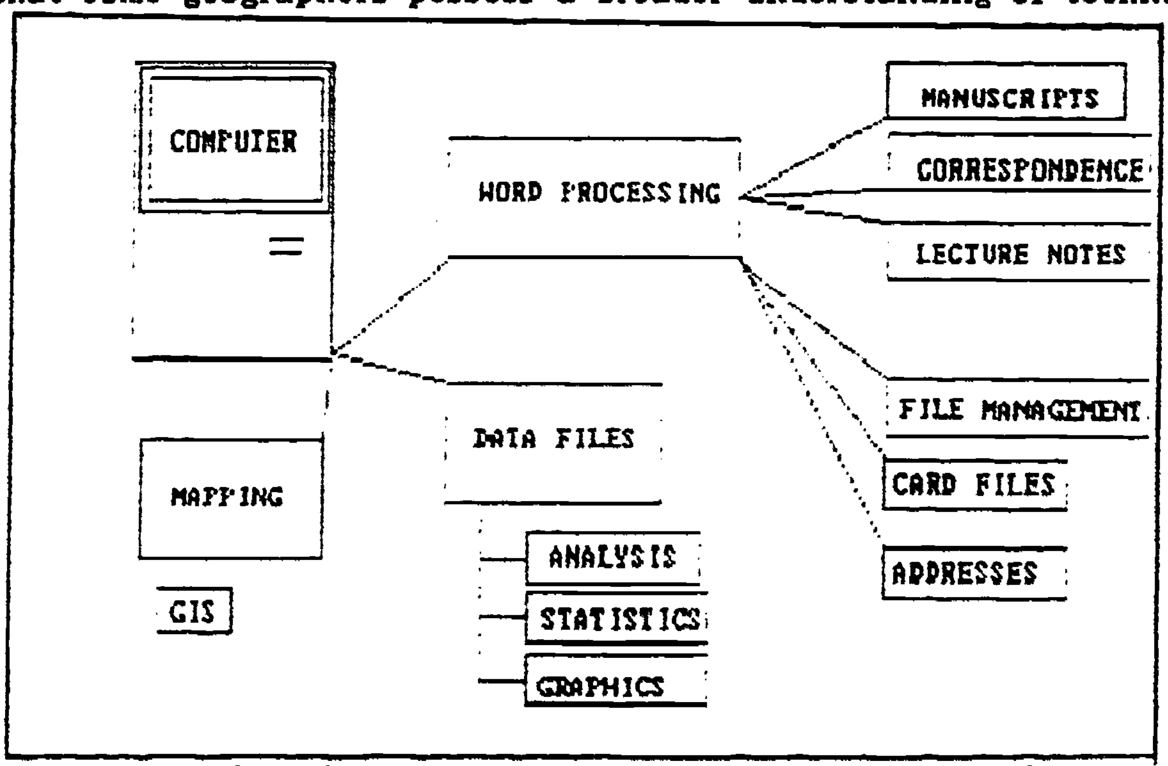

Figure 6 A "Hard Technology" View including the Concept of Networking

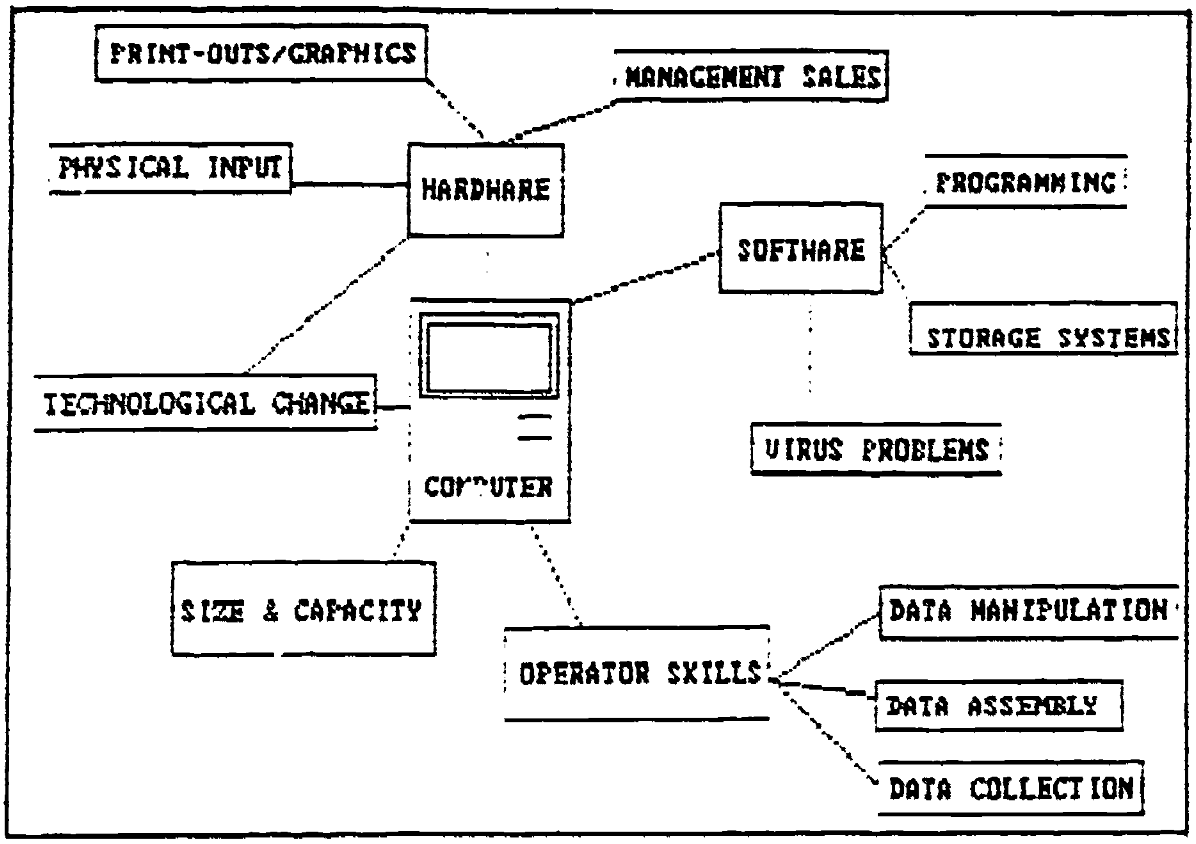

Figure 7 A "Hard Technology" View including Management Skills

There were, however, a number of cynics who saw technology as useful, but often an agent for social control and wasted effort (Figure 8) or as a source of frustration and of limited benefit (Figure 9). These graphics introduce the idea of the attitudes of geographers towards computers which will be discussed in the next section of analyses.

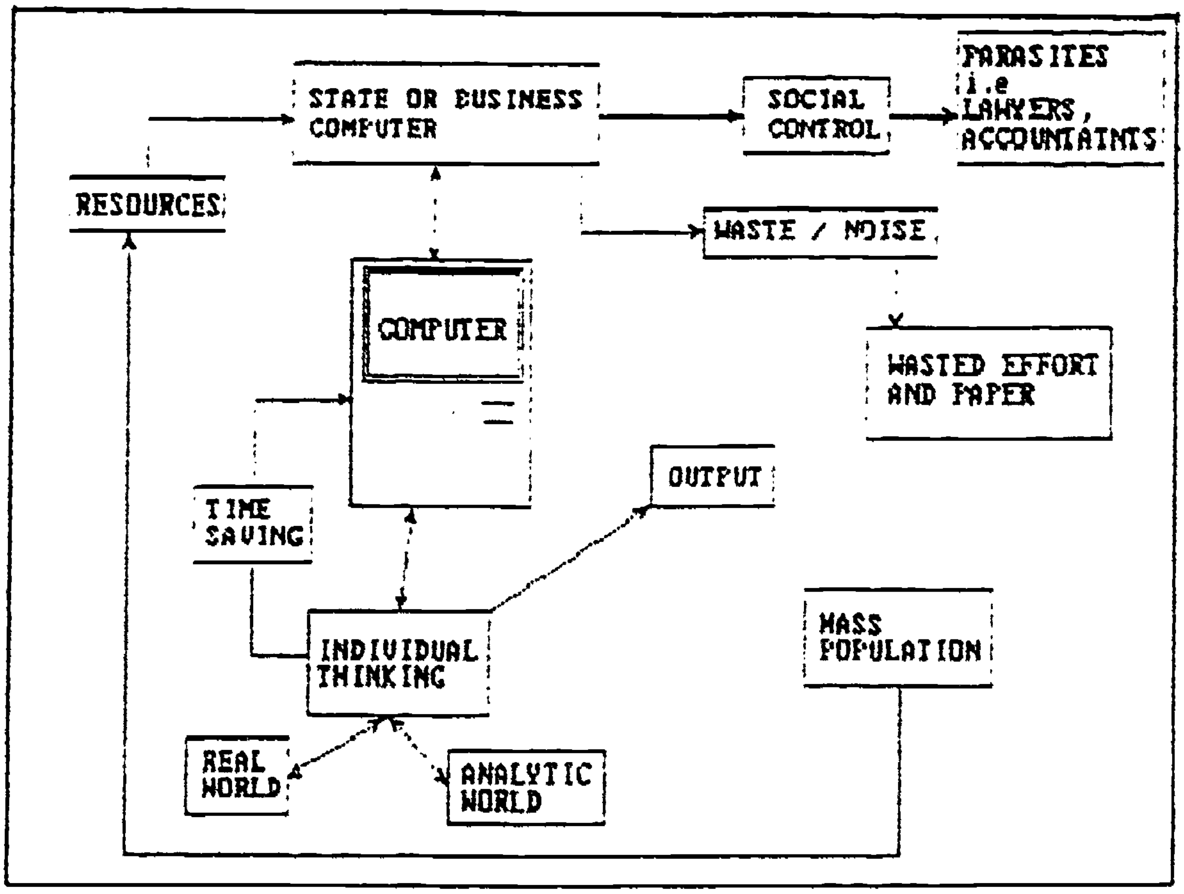

Figure 8 A Cynical View of Technology as an Agent of Social Control and Wasted Effort

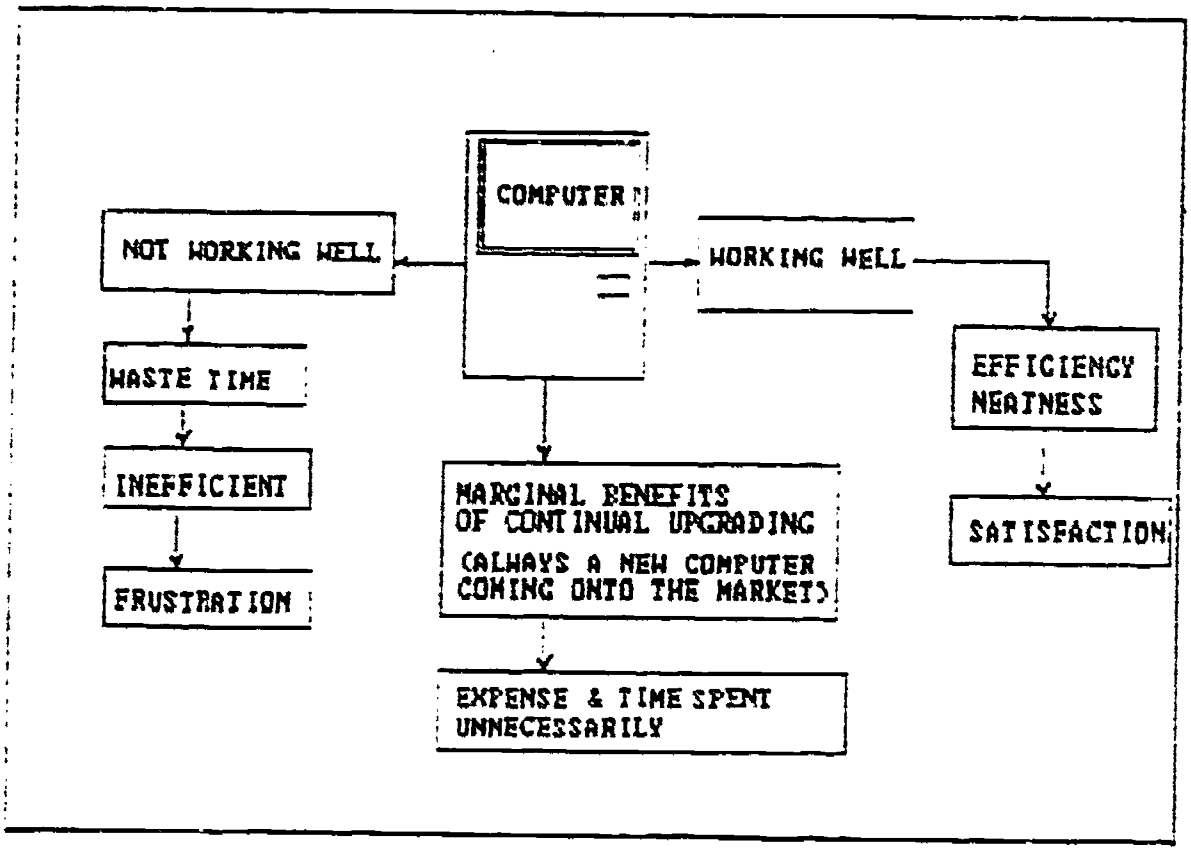

Figure 9 A Cynical view of Technology as a Source of Frustration and of Limited Benefit

2. Attitudes of geographers towards technology.
It was demonstrated earlier in this document that people involved in education tend to be ambivalent towards technology. The attitudes of the geographers in this study were determined by asking them to respond to the following nine statements:
(a) Most of the world's problems will be solved by technology. (Tech.Att.1)
(b) Technology improves your personal lifestyle. (Tech.Att.2)
(c) Technology offers increased employment opportunities. (Tech.Att.3)
(d) Technology makes education more interesting. (Tech.Att.4)
(e) Technology encourages one's creativity and imagination. (Tech.Att.5)
(f) People can rely on technology to make decisions for them. (Tech.Att.6)
(g) Technology can be used effectively in both the arts and the sciences. (Tech.Att.7)
(h) People can use their leisure time more effectively because of technology. (Tech.Att.8)
(i) It is possible to control the impact of new technologies on our society. (Tech.Att.9)
Each of these statements was constructed to either focus on an aspect of living in which technology is or can be employed or to consider the impact of technology on society.

The extent to which the geographers agreed with these statements is summarised in Table 8. These results reveal that the geographers generally agree with the propositions that technology: improves one's personal lifestyle (72.7%), offers increased employment opportunities (56.9%), makes education more interesting (59.1%), can be relied upon to make decisions for people (81.9%) and that people can use their leisure time more effectively because of technology (47.8%). On the other hand, they generally disagreed with the propositions that technology: can solve most of the world's problems (81.9%) and it encourages one's creativity and imagination (68.1%). They were divided on whether technology can be used effectively in both the arts and the sciences and whether it is possible to control the impact of new technologies on our society. These results indicate that the geographers in this sample are favourably disposed towards technology in different aspects of living (including education). However, they do not see technology as the panacea of the world's problems.

Table 8 Attitudes of Participating Geographers to Technology Expressed as Ratings (Percentages) (N = 88)

ATTITUDINAL STATEMENTS	TOTALLY AGREE	AGREE	NOT SURE	DISAGREE	TOTALLY DISAGREE
Tech. Att. 1	-	6 (6.8)	10 (11.3)	46 (52.3)	26 (29.6)
Tech. Att. 2	4 (4.6)	60 (68.1)	12 (13.6)	10 (11.3)	2 (2.3)
Tech. Att. 3	4 (4.6)	46 (52.3)	20 (22.3)	10 (11.3)	8 (9.1)
Tech. Att. 4	2 (2.3)	50 (56.8)	14 (15.9)	14 (15.9)	8 (9.1)
Tech. Att. 5	4 (4.6)	16 (18.2)	8 (9.1)	40 (45.4)	20 (22.7)
Tech. Att. 6	34 (38.6)	38 (43.2)	10 (11.3)	4 (4.6)	2 (2.3)
Tech. Att. 7	8 (9.1)	28 (31.9)	24 (27.2)	20 (22.7)	8 (9.1)
Tech. Att. 8	4 (4.6)	38 (43.2)	32 (36.3)	12 (13.6)	2 (2.3)
Tech. Att. 9	2 (2.3)	20 (22.7)	30 (34.2)	24 (27.2)	12 (13.6)

Spearman correlation coefficients were computed to establish if there were any relationships between the geographers' attitudes and each of the five independent variables. The results of these calculations are summarised in Table 9. They indicate that there are no significant relationships amongst the geographers' attitudes to technology on the basis of gender, academic position, age and years of experience in higher education. Significant relationships were found between groups of the geographers on the basis of their major field of interest and their attitudes to the propositions that:
1. technology encourages one's creativity and imagination, and
2. people can rely on technology to make decisions for them.
The interpretation, here, is that those geographers whose main field of interest is geographical information which involves more hard technology would be more favourably disposed to these statements than groups such as physical and human geographers. The geographical information specialists who have greater competence in hard technologies probably have greater appreciation of the possibilities of technology for living.

Table 9 Spearman Correlation Coefficients to Indicate Relationships between Five Independent Variables and the Geographers' Attitudes towards Technology (Probability) (N=88)

ATTITUDINAL STATEMENTS	GENDER	ACADEMIC POSITION	MAIN FIELD OF INTEREST	AGE	HIGHER EDUC. EXP.
Tech. Att. 1	-0.05289 (0.7362)	-0.16009 (0.3051)	-0/18275 (0.2408)	0.11955 (0.4451)	-0.21800 (0.1602)
Tech. Att. 2	0.05446 (0.7287)	-0.20547 (0.1862)	-0.05815 (0.7111)	0.23088 (0.1363)	0.05119 (0.7444)
Tech. Att. 3	0.14298 (0.3604)	-0.12716 (0.4165)	0.03767 (0.8105)	0.09691 (0.5365)	-0.17550 (0.2603)
Tech. Att. 4	0.14970 (0.3380)	-0.18751 (0.2286)	-0.11731 (0.4537)	-0.03344 (0.8314)	0.01373 (0.9301)
Tech. Att. 5	-0.10965 (0.4840)	-0.02999 (0.8486)	-0.29786 (0.0524)*	-0.02632 (0.8670)	-0.13636 (0.3864)
Tech. Att. 6	-0.24139 (0.1189)	0.14551 (0.3518)	-0.34490 (0.0235)*	0.14801 (0.3435)	0.02527 (0.8722)
Tech. Att. 7	-0.02468 (0.8752)	-0.14848 (0.3420)	0.00055 (0.9972)	0.00710 (0.9639)	0.06542 (0.6768)
Tech. Att. 8	-0.03343 (0.8315)	-0.16742 (0.2832)	0.03982 (0.7998)	0.06110 (0.6971)	-0.07630 (0.6268)
Tech. Att. 9	-0.03998 (0.7991)	-0.07232 (0.6449)	0.11005 (0.4824)	0.06610 (0.6737)	-0.10572 (0.4999)
Total Attitude Score	-0.01620 (0.9179)	-0.17830 (0.2526)	-0.11053 (0.4805)	-0.00726 (0.9631)	-0.06858 (0.6621)

* = Significant at the 0.05 level

3. Competence in technology.

Having found out what these geographers understand about technology and feel about it, it is appropriate to determine their perceived degree of competence in the different technologies. This was achieved by seeking two levels of response from the geographers concerning a range of hard and soft technologies. These levels consisted of asking the geographers:

1. Do you know what this technology is? and
2. Are you able to use this technology effectively?

The geographers were also asked to provide any explanatory comments which they felt would explain their situation more fully. In addition, Spearman's correlation coefficients were calculated to establish any relationships between any of the five independent variables and the geographers' perceived competence in technology.

Table 10 provides a summary of the geographers' perceived knowledge of particular technologies. The first eighteen examples of technology may be defined as hard technologies and the five remaining examples may be defined as soft technologies. Of the hard technologies, it is evident that these geographers know about all of them except for laser vision disks and opaque projectors. Of the soft technologies, the geographers were generally aware of all of them with the exception of enterprising skills.

Table 10 Geographers' Knowledge of Selected Hard and Soft Technologies (Percentage) (N=88)

TECHNOLOGY ITEM	YES	NO
Personal computer	84 (95.4)	4 (4.6)
Statistical software	86 (97.7)	2 (2.3)
G I S Software	82 (93.1)	6 ([illegible])
Remote Sensing Software	78 (88.6)	10 (11[illegible])
Facsimile (Fax) Machine	84 (95.4)	4 (4.6)
Videorecorder	86 (97.7)	2 (2.3)
Compact Disks	86 (97.7)	2 (2.3)
Laser Vision Disks	42 (47.7)	46 (52.3)
Overhead Projectors	84 (95.4)	4 (4.6)
Opaque Projector	34 (38.6)	54 (61.4)
Slide Projector	88 (100.0)	-
Videoprojector	84 (95.4)	4 (4.6)
Electronic Mail	86 (97.7)	2 (2.3)
Electronic Bulletin Board	74 (84.1)	14 (15.9)
Audiocassette Recorder	86 (97.7)	2 (2.3)
Teleconference Equipment	72 (81.8)	16 (18.2)
Databases	84 (95.4)	4 (4.6)
Word Processing Software	82 (93.1)	6 (6.9)
Enterprising Skills	26 (29.5)	62(70.5)
Interpersonal Communication Skills	64 (72.7)	24 (27.3)
Management/Leadership Skills	68 (77.2)	20 (22.7)
Networking	74 (84.0)	14 (16.0)
Design Skills	58 (65.9)	30 (34.1)

By contrast, in Table 11 the geographers were asked to nominate their ability to use these examples of hard and soft technology . This data will provide an indication of their actual competence in technology, but it stops short of actually testing this competence in an applied situation. This latter aspect was beyond the scope of this investigation. As expected, the results that are summarised in Table 11 indicate that these geographers did feel competent to use the following hard technologies: A personal computer, statistical software, GIS software, a facsimile machine, a videorecorder, compact disks, an overhead projector, a slide projector, a videoprojector, an audio-cassette recorder, databases and word processing software. They did not feel competent to use: remote sensing software, laser vision disks, an opaque projector, electronic mail, an electronic bulletin board and teleconference equipment. The general impression to be gained from these results is that these geographers feel competent in the established hardware that they use in their professional activities. However, they do not feel competent to use some of the latest hard technologies. As for the soft technologies listed in the survey, the geographers did not feel competent to use enterprising skills and design skills. This result probably reflects the fact that these technologies are not emphasised in their academic units.

Table 11 Geographers' Use of Selected Hard and Soft Technologies (Percentages) (N=88)

TECHNOLOGY ITEM	YES	NO
Personal computer	80 (90.9)	8 (9.1)
Statistical software	78 (88.6)	10 (11.3)
G I S software	58 (65.9)	30 (34.1)
Remote sensing software	38 (43.1)	50 (56.9)
Facsimile (Fax) machine	74 (84.0)	14 (16.0)
Videorecorder	74 (84.0)	14 (16.0)
Compact disks	70 (79.5)	18 (20.5)
Laser Vision disks	24 (27.2)	64 (72.8)
Overhead projector	84 (95.4)	4 (4.6)
Opaque projector	28 (31.8)	60 (68.2)
Slide projector	86 (97.7)	2 (2.3)
Videoprojector	54 (61.3)	34 (38.7)
Electronic mail	46 (52.2)	42 (47.8)
Electronic bulletin board	38 (43.1)	50 (56.9)
Audio-cassette recorder	80 (90.9)	8 (9.1)
Teleconference equipment	36 (40.9)	52 (59.1)
Databases	76 (86.3)	12 (13.7)
Word processing software	76 (86.3)	12 (13.7)
Enterprising skills	28 (31.8)	60 (68.2)
Interpersonal communication skills	66 (75.0)	22 (25.0)
Management/Leadership skills	64 (72.7)	24 (27.3)
Networking	52 (59.0)	36 (41.0)

Design skills	40 (45.4)	48 (54.6)

The comments that were associated with these tasks were quite polarised. Generally, the geographers who were quite at ease with technology made few comments or if they did these were couched in the following terms:

"I assume that all university people would be familiar with these."

The more vociferous responses were from geographers who felt ill at ease with technology. They are typified by the following statements:

- "This whole world is passing me by. I write lecture notes, articles and books long hand and have them typed. Presumably, the typist uses some of the items on the list, but I have no knowledge of them."
- "I was born too early. My research needs were established in the notebook and calculator days. My subsequent "urgent" tasks were all interpersonal and thus I never had(or made) the time to learn how to use the new technologies. I could have, had I thought them important enough for my own work to devote the time in learning the skills, but there was always a file of urgent paper in the in-tray requiring "pencil" solutions immediately."

Spearman correlation coefficients were calculated for each of the five independent variables and the geographers' perceived knowledge of and competence with hard and soft technologies. The results of these studies are summarised in Tables 12 and 13 respectively. In Table 12 it is revealed that there are no significant relationships between the groups of geographers on the basis of gender, academic position, major field of interest, age and experience in higher education and their perceived knowledge of selected hard and soft technologies.

Table 12 Spearman Correlation Coefficients Between Five Independent Variables for Participating Geographers and Their Perceived Knowledge of Selected Hard and Soft Technologies (Probability) (N=88)

ITEMS	GENDER	ACADEMIC POSITION	FIELD OF INTEREST	AGE	HIGHER EDUC.EXP.
Knowledge of hard technologies	0.14030 (0.3695)	-0.04575 (0.7660)	-0.29227 (0.0572)	0.02622 (0.8674)	0.02484 (0.8744)
Knowledge of soft technologies	-0.09671 (0.5373)	-0.06814 (0.6642)	-0.13915 (0.3735)	0.12810 (0.4130)	-0.00498 (0.9747)
Knowledge of hard and soft technologies	0.05234 (0.7389)	-0.18221 (0.2422)	-0.26294 (0.0885)	0.01125 (0.9429)	0.03971 (0.8004)

The picture in regard to the geographers' perceived competencies in hard and soft technologies, as revealed in Table 13, indicates that significant relationships do exist between the groups of geographers as defined by their major field of interest and: their perceived competencies in hard technologies and the combined totals for hard and soft technologies. Again, this could be interpreted to mean that groups such as the geographical information specialists do possess a higher level of competence in technology than some other groups of geographers represented in this study.

Table 13 Spearman Correlation Coefficients Between Five Independent Variables for Participating Geographers and their Perceived Competencies in Selected Hard and Soft Technologies (Probability) (N=88)

ITEM	GENDER	ACADEMIC POSITION	MAJOR FIELD OF INTEREST	AGE	HIGHER ED. EXP.
Competence in selected hard technologies	-0.13324 (0.3944)	0.07311 (0.6413)	-0.48483 (0.0010)*	0.09094 (0.5619)	0.10253 (0.5130)
Competence in selected soft technologies	-0.00985 (0.9500)	0.03372 (0.8300)	-0.24272 (0.1168)	0.14476 (0.3543)	0.09497 (0.5447)
Competence in selected hard and soft technologies	-0.12312 (0.4315)	0.12017 (0.4428)	-0.37643 (0.0128)*	0.19943 (0.1998)	0.07955 (0.6121)

4. The geographers' use of technology in their professional activities.
The data concerning the geographers' use of technology in their professional activities consists of two components - firstly, data concerning their access to selected hard technologies and secondly, data concerned with their declared actual use of technology in teaching, research and consultancy. The geographers were encouraged to make a number of explanatory comments regarding their responses in these tasks. Again, Spearman correlation coefficients were calculated to determine if there are any significant relationships between the five independent variables and the geographers' access and use of selected hard technologies.

The geographers' access to hard technologies is summarised in Table 14. From this data, it is evident that the geographers have regular access to the following hard technologies: personal computer, facsimile machine, videorecorder, audiocassette recorder, overhead projector, slide projector, statistical software, databases and word processing software. They have occasional access to a videoprojector, compact disks, GIS software, remote sensing software and electronic mail. Also, it is evident that they do not access to an opaque projector, laser vision disks, electronic bulletin boards and teleconference equipment.

Table 14 Geographers' Access to Selected Items of Hard Technology (Percentage) (N=88)

ITEM	REGULAR USE	OCCASIONAL USE	NEVER USED
Personal computer	76 (86.4)	6 (6.8)	6 (6.8)
Facsimile machine	70 (79.6)	12 (13.6)	6 (6.8)
Videorecorder	67 (76.1)	10 (11.3)	11 (12.6)
Audiocassette recorder	66 (76.0)	16 (18.2)	6 (6.8)
Overhead projector	88 (100.0)	-	-

Opaque projector	18 (20.4)	4 (4.6)	66 (75.0)
Slide Projector	72 (81.8)	16 (18.2)	-
Video projector	38 (43.2)	22 (25.0)	28 (31.8)
Compact disks	16 (18.2)	46 (52.2)	26 (29.6)
Laser vision disks	2 (2.3)	12 (13.6)	74 (84.1)
Statistical software	60 (68.1)	18 (20.4)	10 (11.3)
GIS software	32 (36.3)	28 (31.8)	28 (31.8)
Remote sensing software	26 (29.5)	22 (25.0)	40 (45.5)
Databases	54 (61.4)	28 (31.8)	6 (6.8)
Word processing software	82 (93.2)	-	6. (6.8)
Electronic mail	28 (31.8)	24 (27.2)	36 (41.0)
Electronic bulletin board	12 (13.6)	28 (31.8)	48 (54.6)
Teleconference equipment	12 (13.6)	28 (31.8)	48 (54.6)

Spearman correlation coefficients were calculated to determine any significant relationships between the five independent variables and the geographers' access to technology. The results of these computations are summarised in Table 15. Here it is revealed that a significant negative relationship exists between the major fields of interest of the geographers and their access to hard technologies.

Table 15 Spearman Correlation Coefficients Between Five Independent variables and Geographers' Access to Selected Hard Technologies. (Probability) (N=88)

ITEM	GENDER	ACADEMIC POSITION	MAJOR FIELD OF INTEREST	AGE	HIGHER EDUC.EXP.
Access to hard technologies	-0.15838 (0.3104)	-0.01765 (0.9105)	-0.50744 (0.0005)*	-0.06736 (0.6678)	-0.01007 (0.9489)

The question of actual use of items of hard technology in their professional activities was addressed with specific reference to teaching, research and consultancy. In each of these cases the geographers were asked to rate their use of the above selection of hard technologies on a three point scale. The results of their usage are summarised for teaching in Table 16, research in Table 17 and for consultancy in Table 18.

The use of these hard technologies in geography teaching at the higher education level reveals a set of mixed results. The geographers indicate that they make regular use of the following items of technology: A personal computer, an overhead projector, a slide projector, and wordprocessing software. They make occasional use of a videorecorder. However, they generally never use the following items in their teaching: a facsimile machine, an opaque projector, a videoprojector, compact disks, laser vision disks, GIS software, electronic mail, electronic bulletin boards and teleconference equipment. This is a rather dismal picture in terms of the use of technology in teaching geography in higher education. There may be a number of explanations for this situation. Obviously, access to the equipment is one factor. However, it could be that most geographers are engaged in face-to-face lecturing with associated workshops. Therefore, the geographers use rather conventional lecturing techniques associated with overhead projectors and slide projectors and associated workshops that may involve the use of personal computers.

Table 16 Participating Geographers Use of Selected Hard Technologies in their Teaching (Percentages) (N=88)

ITEM	REGULAR USE	OCCASIONAL USE	NEVER USED
Personal computer	46 (52.4)	24 (27.2)	18 (20.4)
Facsimile machine	6 (6.8)	36 (40.8)	46 (52.4)
Videorecorder	20 (22.7)	50 (56.9)	18 (20.4)
Audiocassette recorder	28 (31.8)	34 (38.6)	26 (29.6)
Overhead projector	82 (93.1)	4 (4.6)	2 (2.3)
Opaque projector	6 (6.8)	14 (15.9)	68 (77.3)
Slide projector	58 (65.9)	28 (31.8)	2 (2.3)
Videoprojector	10 (11.3)	34 (38.6)	44 (50.0)
Compact disks	4 (4.6)	32 (36.4)	52 (59.0)
Laser vision disks	-	2 (2.3)	86 (97.7)
Statistical software	22 (25.0)	32 (36.4)	34 (38.6)
GIS software	14 (15.9)	24 (27.7)	50 (56.4)
Remote sensing software	12 (13.6)	14 (15.9)	62 (70.5)
Databases	26 (29.5)	32 (36.3)	30 (34.2)
Word processing software	52 (59.1)	14 (15.9)	22 (25.0)
Electronic mail	6 (6.8)	14 (15.9)	68 (77.3)
Electronic bulletin board	4 (4.6)	10 (11.3)	74 (84.1)
Teleconference equipment	4 (4.6)	16 (18.1)	68 (77.3)

The geographers were less positive in their use of technology in their research. As Table 17 reveals, the only ones of the selected hard technologies that they used regularly in their research are a personal computer, databases and wordprocessing software. There was a divided response to the use of facsimile machines, slide projectors and statistical software. The geographers did not report substantial use of more recent technologies such as compact disks, laser vision disks, GIS software, remote sensing software or electronic mail in their research. This reflects a rather narrow use of hard technologies in their research studies by the geographers.

Table 17 Participating Geographers Use of Selected Hard Technologies in their Research (Percentages) (N=88)

ITEM	REGULAR USE	OCCASIONAL USE	NEVER USED
Personal computer	62 (70.5)	12 (13.6)	14 (15.9)
Facsimile machine	36 (40.9)	38 (43.2)	14 (15.9)
Videorecorder	8 (9.1)	30 (34.0)	50 (56.9)
Audiocassette recorder	8 (9.1)	38 (43.2)	42 (47.7)
Overhead projector	14 (15.9)	34 (38.6)	40 (45.5)
Opaque projector	6 (6.8)	4 (4.6)	78 (88.6)
Slide projector	16 (18.2)	34 (38.6)	38 (43.2)
Videoprojector	2 (2.3)	14 (15.9)	72 (81.8)
Compact disks	10 (11.3)	28 (31.8)	50 (56.9)
Laser vision disks	-	8 (9.1)	80 (90.9)
Statistical software	42 (47.7)	30 (34.0)	16 (18.2)
GIS software	20 (22.7)	26 (29.5)	42 (47.7)
Remote sensing software	14 (15.9)	28 (31.8)	46 (52.3)
Databases	46 (52.3)	26 (29.5)	16 (18.2)
Word processing software	62 (70.5)	10 (11.3)	16 (18.2)
Electronic mail	14 (15.9)	24 (27.2)	50 (56.9)
Electronic bulletin board	8 (9.1)	18 (20.4)	62 (70.5)
Teleconference equipment	4 (4.6)	12(13.6)	72 (81.8)

The geographers' pattern of use of hard technologies in their consultancies bears a similarity to their use of them in their research. As Table 18 reveals, the only ones of the selected hard technologies that the geographers used regularly in their consultancies were a personal computer, a facsimile machine and word processing software. Again, these results indicate that geographers in Australian institutions of higher education make limited use of hard technology in their consultancies.

Table 18 Participating Geographers' Use of Selected Hard Technologies in their Consultancies (Percentage) (N=88)

ITEM	REGULAR USE	OCCASIONAL USE	NEVER USED
Personal computer	52 (59.1)	14 (15.9)	22 (25.0)
Facsimile machine	40 (45.4)	26 (29.5)	22 (25.0)
Videorecorder	4 (4.6)	14 (15.9)	70 (79.5)
Audiocassette recorder	6 (6.8)	14 (15.9)	68 (77.3)
Overhead projector	20 (22.7)	14 (15.9)	54 (61.4)
Opaque projector	-	2 (2.3)	86 (97.7)
Slide projector	16 (18.2)	14 (15.9)	58 (65.9)
Videoprojector	4 (4.6)	8 (9.1)	76 (86.3)
Compact disks	4 (4.6)	12 (13.6)	72 (81.8)
Laser vision disks	2 (2.3)	4 (4.6)	82 (93.1)
Statistical software	20 (22.7)	24 (27.3)	44 (50.0)
GIS software	16 (18.1)	16 (18.1)	56 (63.8)
Remote sensing software	8 (9.1)	24 (27.3)	56 (63.6)
Databases	20 (22.7)	26 (29.5)	42 (47.8)
Word processing software	46 (52.2)	14 (15.9)	28 (31.9)
Electronic mail	8 (9.1)	16 (18.1)	64 (72.8)
Electronic bulletin board	8 (9.1)	18 (20.4)	62 (70.5)
Teleconference equipment	12 (13.6)	6 (6.8)	70 (79.6)

Spearman correlation coefficients were computed to check for any significant relationships between the five independent variables and the geographers' use of hard technologies in their teaching, research and consultancy. The results of these calculations are summarised in Table 19. They indicate that there is a significant negative correlation between the major fields of interest for these geographers and their use of hard technologies for teaching. On the basis of the scoring of the geographers' responses this relationship indicates that the geographical information specialists and possibly the physical geographers made more use of hard technologies in their teaching than the geographers in the other fields. There are no significant relationships between gender, academic position, age and experience in higher education and the use of hard technologies for teaching.

In terms of their use of hard technologies in research, two significant relationships were found to exist. These were a negative relationship between major fields of interest and the use of hard technologies for research and a positive relationship between the ages of the geographers and their use of hard technologies for research purposes. On the basis of the scoring methods, these results may be interpreted as the greater use of hard technologies in research by geographers working in geographical information and physical geography and an increased use of technology by the younger geographers.

No significant relationships were established between any of the five independent variables and the geographers' use of hard technology in consultancy activities.

Table 19 Spearman Correlation Coefficients between Five Independent Variables for Participating Geographers and their Use of Hard Technologies in Teaching, Research and Consultancy (Probability) (N=88)

ITEM	GENDER	ACADEMIC POSITION	MAJOR FIELD OF INTEREST	AGE	HIGHER EDUC.EXP.
Use of Hard Tech. in Teaching	-0.08100 (0.6056)	0.10749 (0.4927)	-0.45157 (0.0024)*	-0.06629 (0.6728)	-0.05651 (0.7189)
Use of Hard Tech. in Research	-0.17788 (0.2538)	0.02557 (0.8707)	-0.45663 (0.0021)*	0.31310 (0.0409)*	-0.02382 (0.8795)
Use of Hard Tech. in Consultancy	-0.06143 (0.6955)	-0.12994 (0.4063)	-0.20103 (0.1961)	0.09418 (0.5480)	-0.05186 (0.7412)

* = Significant at 0.05 level

5. Perceived impact of technology on geographers' professional activities.
The final set of tasks for the geographers consisted of them rating the overall impact that they believed that technology had on their professional activities. This was achieved by having them rate this impact on a four-point scale ranging from a score of 4 for extensive impact to a score of 1 for no impact. In addition, the geographers were asked to list specific examples of ways in which technology had impacted on their teaching, research and consultancy. Finally, Spearman correlation coefficients were calculated to determine if there were any significant relationships between the five independent variables and the perceived impact of technology.

The geographers perceived there has been a considerable impact of technology on their professional activities. As Table 20 indicates, the mean score of these geographers was 3.16279 with a median score of 3.0. Despite some of the earlier results and some of the comments from the geographers, they believe that technology has had a considerable impact on their professional lives.

Table 20 Summary of the Perceived Impact that Technology has had on the Professional Activities of Participating Geographers (N=88)

ITEM	MEAN SCORE	STANDARD DEVIATION	MEDIAN SCORE
Perceived impact of technology	3.16279	0.81446	3.0

When the geographers were asked to list examples of several specific ways in which technology had impacted on their teaching they provided a comprehensive range of items some of which had been included in the previous lists in the survey. A summary of the frequency of these responses is found in Table 21. Predictably, the main impacts for teaching have come in the form of computers, word processors ,videorecorders and overhead projectors. Limited impact of new technologies is noted. This supports the earlier findings on access and use of technology.

Table 21 Examples of Technologies that have Impacted on the Teaching of Participating Geographers (N=88)

ITEM	FREQUENCY OF RESPONSES	ITEM	FREQUENCY OF RESPONSES
Word processing software	26	Photocopier	4
Videorecorder	24	Coloured photographs	2
Computers	12	Calculators	2
Overhead projector	10	Television	2
Slides	8	Compact disks	2
Databases	8	GIS software	2
Remote sensing	6	Camera	2
Graphics	4	Statistics software	2

The ways in which technology has impacted on the research of the geographers again reflects the heavy emphasis which they place on hard technologies. As Table 22 shows, the geographers use a greater variety of hard technologies for research than they do for teaching. This list is the first time in the survey that the geographers have indicated a diversity of items of technology including a range of equipment and software. There is still no emphasis on soft technologies in this list.

Table 22 Examples of Technologies that have Impacted on the Research of the Participating Geographers (N=88)

ITEM	FREQUENCY OF RESPONSES	ITEM	FREQUENCY OF RESPONSES
Word processing software	30	GIS software	4
Statistics programs	16	Photocopier	2
Computers	10	Transport to fieldwork	2
Rapid access to databases	10	Helicopter and aircraft	2
Data processing	10	Surveying machines	2
Communications	10	Videoprojector	2
Facsimile machine	8	Research tools	2
Data presentation	8	Calculator	2
Graphics	6	Colour printing	2
Spread sheets	4	Camera lenses	2
Remote sensing	4		

The impact of technology on the consultancies that these geographers undertake is summarised in Table 23. They reflect a strong similarity to those noted in regard to research. The uses of computers and databases, together with communications technology such as facsimile machines are the most obvious technological impacts. Most of these examples are general purpose examples of hard technologies rather than specific examples of dedicated technology.

Table 23 Examples of Technologies that have Impacted on the Consultancies of Participating Geographers (N=88)

ITEM	FREQUENCY OF RESPONSES	ITEM	FREQUENCY OF RESPONSES
Word processing software	24	Software	4
Facsimile machine	10	Photocopier	2
Databases	10	Transport to fieldwork	2
Personal computer	10	Other computers	2

Statistics programs	8	Videorecorder	2
Remote sensing	6	Laser processing	2
Graphics	6	GIS software	2
Communications	6		

Spearman correlation coefficients were calculated to determine the significance of the relationships between each of the five independent variables and the perceived general impact of technology of the professional activities of the geographers. The results of these calculations are presented in Table 24. They indicate that there is a significant negative relationship between the geographers' major field of interest and their perceived technological impact. Based on the scoring system, this relationship means that geographers who specialise in geographical information have the highest perceived impact followed by physical geographers then human geographers, regional and economic geographers in that order. However, there were no significant relationships with the groupings of geographers based on gender, academic position, age and experience in higher education.

Table 24 Spearman Correlation Coefficients between five Independent Variables and the Perceived Impact of Technology on the Professional Activities of Participating Geographers (Probability) (N=88)

ITEM	GENDER	ACADEMIC POSITION	MAJOR FIELD OF INTEREST	AGE	HIGHER EDUC.EXP.
Perceived impact of technology	−0.21386 (0.1685)	−0.04515 (0.7737)	−0.42297 (0.0047)*	0.19460 (0.2111)	−0.08339 (0.5950)

* = Significant at 0.05 level

INTERPRETATION AND IMPLICATIONS FOR GEOGRAPHY IN HIGHER EDUCATION IN AUSTRALIA

The survey of Australian geographers in institutions of higher education provides a picture of a group of academics who conceptualise technology as a wide range of objects ("tools for the job") which require certain skills, procedures or techniques for their operation. Technology is not generally perceived to focus on aspects of organisation. These geographers see technology in the form of a range of hard technologies and they pay little attention to the methods for organising the hardware, i.e. the soft technologies. No only are these geographers biased toward hard technologies, but they are not well informed about the latest hard technologies that are impacting on industry and education. Such hardware as laser vision disks, teleconferencing equipment and electronic bulletin boards are not well known. A strong reliance on personal computers and associated software for word processing and statistical analyses seems to characterise the currency of technological activity for this group of geographers.

Those geographers who specialise in geographical information seem to be the exception to this picture. They are the academics who have experienced greatest exposure to new hard technologies and they are the group who have made greatest use of GIS and remote sensing software in their professional activities. However, even this group of geographers still retain a narrow view of technology. Because of the technical bias to their activities, these geographers seem quite satisfied with the prevailing hard technological situation. This is a satisfaction that needs to be challenged for it is this group of geographers who should lead to expansion of technology in geography in higher education.

Most of the participants in this study are experienced geographers in Australian universities. A considerable number of them are the academic leaders in their organisational units in particular universities. They should be the ones that provide the academic leadership in technology. However, it is apparent that a considerable number of these geographers have allowed technology to "pass them by". Instead they have become submerged in administrivia.

Technology is impacting deeply on our Australian society. Industry, commerce and recreation have become transformed by aspects of both hard and soft technology. Higher education which is supposed to lead our society in training, research and development cannot afford to be left behind as far as technological understanding and practice is concerned. However, the evidence collected in this study suggests that many of the geographers in Australian higher education need to be supported to "get up to speed" in both hard and soft technologies. If it is accepted that technology can enhance geography by:

1. expanding the geographers' understanding of spatial aspects of people and their environment;
2. improving the technical skills of geographers;
3. using soft technologies to reinforce inquiry or problem-solving approaches;
4. enhancing the capacity of geographers for research and consultancy; and
5. expanding the opportunities for geographers to improve their networks and communication,

then there should be concern to ensure that more is done by the leading geographers in Australian institutions of higher education to promote technology education within teaching, research and consultancy.

It can be claimed quite legitimately that university departments cannot afford to purchase a wide range of technological items. However, aside from the very expensive specialised items, this is not the real reason why Australian geographers have not embodied technology more strongly. In fact, it is fast becoming an excuse rather than the prime reason. The main reason for the lack of diffusion of technology in its broad concept in university geography departments has been the conception that geographers have held of technology. It has been largely a computer-driven conceptualisation. This accounts for the belief that technology is always very expensive. Since the cost of computers is reducing rapidly, it is possible that this reason for lack of technological activity in geographers may decline.

A lack of active concern for in-service education and training by Australian geographers is likely to account for the rather slow diffusion of technology amongst the geography departments around Australian universities. Research was seen as a priority in Australian universities, but in-service training was not. Any technological skills and techniques that were obtained from research studies were a bonus to the researcher(s). There was no pattern of definite in-service training policies in technology across the geography departments in Australian universities. This allowed those geographers working in areas such as geographical information to become quite heavily involved in newer hard technologies, but many other geographers missed out on these types of experiences. A comprehensive in-service training program would assist in the technological education of many Australian geographers.

The data from this study revealed that Australian geographers have a limited understanding of the concept of soft technologies and that they make little use of such technologies in their professional activities. A thorough understanding of the concept of technology is required if Australian geographers wish to claim leadership in technology education. If such technologies were understood and applied then it is likely that approaches to geography could change and that geography could forge close links with industry for contract research and consultancy as is being encouraged by the Commonwealth Government. Firstly, the geographers would need to undertake in-service experiences to establish their competence in selected soft technologies. Then, they could work closely with industry in collaborative schemes using the Training Guarantee Act, and related projects, to expand the technology education within the broader community.

The attitudes that Australian geographers have towards technology will not change unless they have a range of productive experiences that demonstrate that both hard and soft technologies can be effective and efficient. Not all experiences with technology will be positive and the degree of frustration mentioned by some geographers in the survey will continue. However, there has to be some form of commitment to technology in their teaching and research for Australian geographers to change their prevailing attitudes. Perhaps, one step in this direction would be for universities to provide a personal computer on the desk of every academic. Access to technology would be improved dramatically and after training some of the inherent fears of hard technologies could be reduced.

The challenge for Australian geographers in institutions of higher education is to make a commitment to become active participants in taking our country into the twenty-first century. Whether they like it or not, a part of that commitment involves technology education. While it is common to find many young people who possess the technical skills to use the latest forms of hard technology which exceed those held by many adults, this should not act as a deterrent to academic geographers. These technical skills can be learned just as the young people have learned them. What the academic geographers can do to take leadership in technology is to focus on the soft technologies and use them, together with some hard technologies, to improve teaching, research and consultancy in geography. In so doing they could make a considerable impact on our society - one which continues to demonstrate the relevance of geography to living.

The implications of these actions are that the geographers will develop a broader conceptualisation of technology and that providing a reasonable amount of the hardware is accessible then they are likely to make a stronger use of technology in their teaching, research and consultancy. In doing so, it is very likely that geographers will incorporate apsects of technology education in the learning experiences that they plan for their students. Through deliberate actions such as these Australian geographers can claim to be making a contemporary contribution to developing a stronger alliance with industry and employers.

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